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The State of Electric Power in the South

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ABSTRACT

The electric system in the South faces an array of challenges, which prompted the Georgia Institute of Technology to initiate a study of "The Future of Electric Power in the South." Authored by six Georgia Tech faculty, and informed by a group of stakeholders in the region, this white paper is the first product of the initiative, providing a fact-based description of the current state of electric power in the South. Despite the diversity within the region, a number of features distinguish its power systems from those in the rest of the nation. First, the South has a distinct electricity generation profile. Coal has historically dominated, but in recent years the South has seen a dramatic increase in the fraction of electricity generated by natural gas. The South is also home to all of the nation's current US nuclear reactor construction projects. The Southern states have little renewable generation other than the long-standing hydropower in Tennessee, Alabama, and North Carolina and the significant and more recent wind development in Texas and Oklahoma. The South has a significant opportunity to expand its energy efficiency performance by strengthening its policies. Finally, evidence suggests that the grid in the South is getting smarter, but it is challenged by the need to accommodate distributed renewable generation, increasing demands of a digital society, growing threats to infrastructure security, and concerns over environmental quality and global climate disruption. The region can take pride in the fact that it has never been exposed to the sort of disruptions and blackouts that other parts of the national system have experienced in the past. By acting cautiously in the presence of many challenges, local utilities may have extended the time line of the clean energy transition, but they are also now able to move forward from a strong position.

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The State of Electric Power in the South

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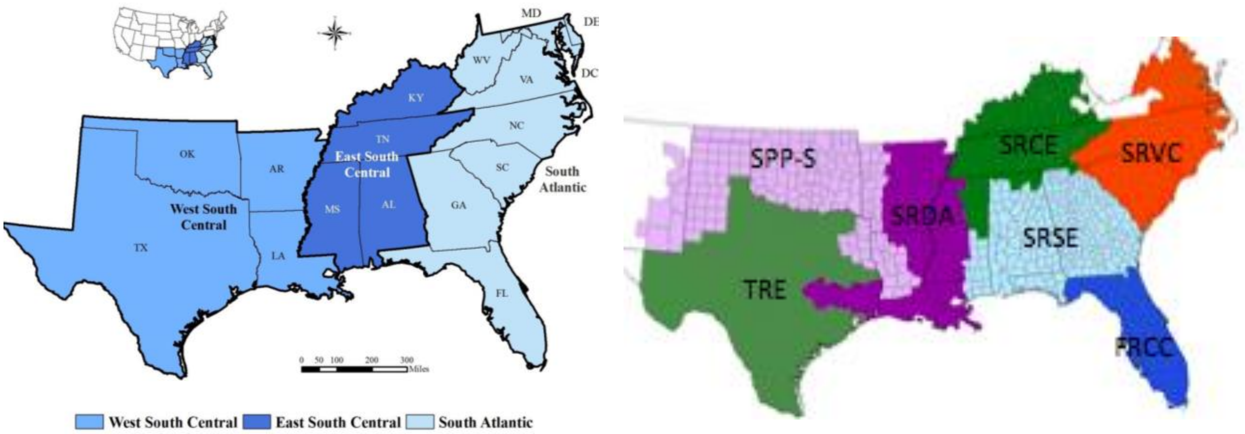
The electric system in the South faces an array of challenges. Sluggish demand growth and increases in distributed resources are expected to pose problems for traditional cost recovery rate structures. At the same time, the digital economy is placing greater value on power quality, and growing cyber threats are requiring increased attention to grid security. Finally, concerns over environmental quality and global climate disruption mean that the energy resources and technologies used over the past several decades to generate electricity need to be transformed (Electric Power Research Institute (EPRI), 2014; Kind, 2013).

Prompted by this convergence of issues, the Georgia Institute of Technology initiated a project focused on "The Future of Electric Power in the South" (FEPS). The FEPS project seeks to facilitate a participatory process for engaging utilities, regulators, and other key stakeholders in a dialog about electric system choices in a future of uncertain economics, policies, and technologies. Clearly, the future prosperity of the South will be influenced by how the region responds to the issues facing its power system.[1] This white paper provides an overview of the state of electric power in the South to engender a common understanding of current conditions, thereby enabling a productive discussion of future options. It focuses, in particular, on the roles that solar photovoltaics (PV) and combined heat and power (CHP) could play in various future scenarios, such as increased policy drivers for minimizing carbon emissions, and in response to alternative stakeholder strategies.

This paper is organized as follows. Sections 1-3 provide an overview of the dominant energy trends and energy sources – coal, natural gas, and nuclear power. Sections 4-5 describe the current state of renewable power and demand-side resources. In these sections we pay particular attention to the current state of solar PV and CHP in the region, as this study is focusing on their possible future roles. Sections 6-7 cover smart grid and grid reliability issues and their relevance to solar PV and CHP integration into power systems. The white paper's conclusions are summarized in Section 8.

There is no universal definition of the South, and because we rely on diverse sources of data and statistics, the geography covered by the South can vary. Perhaps the most common definition used in this paper is the US Census Bureau's Southern Region that is circumscribed by three Census Divisions and includes 16 states along with the District of Columbia (DC) as shown in Figure 1. There are also seven southern regions defined by the North American Electric Reliability Corporation (NERC), which are the basis of much electricity supply data. The NERC regions in the South include four divisions of the Southeast Reliability Council (SRDA, SRCE, SRSE, and SRVC), the Southern Power Pool-South (SPP-S), the Texas Reliability Entity (TRE), and the Florida Reliability Coordinating Council (FRCC).

[1] The link between electricity generation portfolios and metrics of prosperity (such as economic development, clean air and water, energy security, and affordable energy) is well documented.



Census Divisions in the South

NERC Regions the South

Figure 1. Regions in The South

1. The South: Low Electric Rates and Opportunities to Improve Energy Efficiency

Availability of reasonably priced and reliable energy has been a value to businesses and industry in the South and has helped to drive the region's economic development. Historically, residential, commercial, and industrial electricity rates in the South have been substantially below those of the rest of the country, though they have followed similar time paths (Figure 2). These low rates are influenced by the two-peak-season nature of the southern utilities, which lowers average costs. Looking ahead, electricity demand in the South is expected to grow more rapidly than in the rest of the country reflecting the region's relatively strong economy. While electricity rates are projected to rise in every region of the US, the South's rates are expected to remain below the national average (US Energy Information Administration (EIA), 2014).

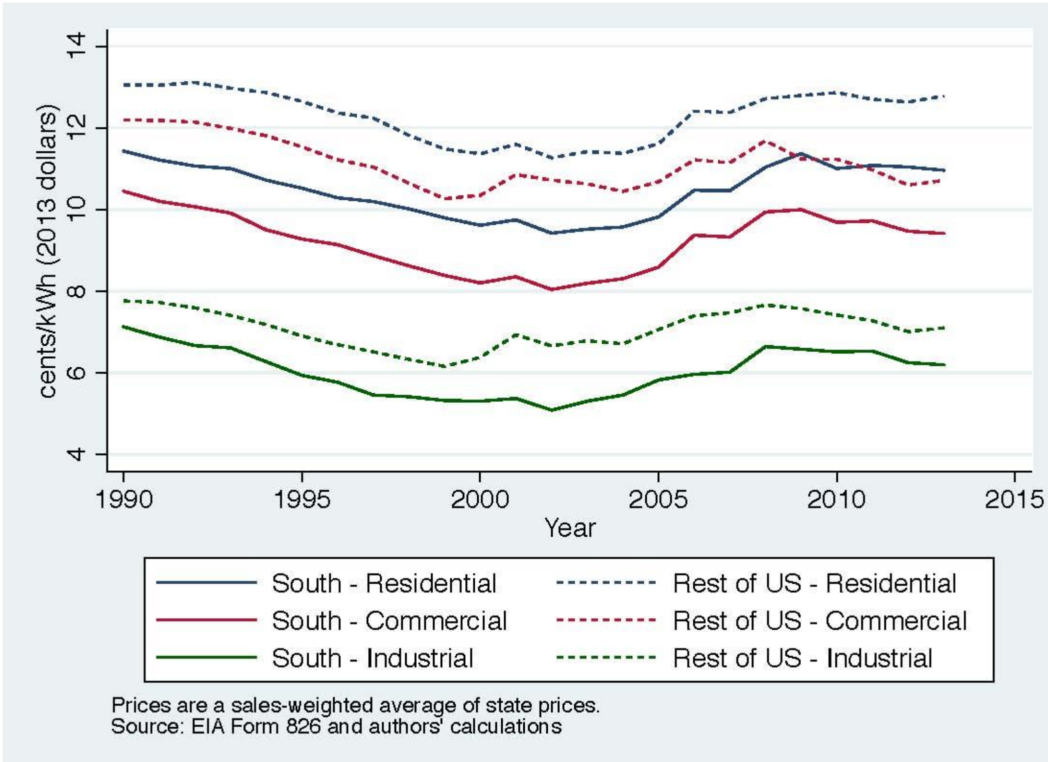


Figure 2. Real Electricity Rates by Region and Customer Class
(Statistics for the "South" exclude Texas and Oklahoma)

These historically low electricity rates have made energy efficiency and conservation less valuable; low electricity rates contribute to the region's intensive use of electricity, consistent with neoclassical economic principles of supply and demand. In addition, the South has invested less in these demand-side resources than other regions of the country as documented below and in Appendix A. In 2013, the South accounted for 43% of US energy consumption and 43% of US electricity consumption (US Energy Information Administration (EIA), 2014), but is home to only 36% of the nation's population and 35% of the US GDP (Bureau of Economic Analysis, 2013). Thus, the region has high ratios of electricity per capita and GDP relative to the rest of the US (Figure 3).

Indicators of delivered electricity intensity are high in each of the three sectors of the economy.[2] In 2012, the industrial sector in the South (which includes manufacturing, agriculture, mining and construction) used 42% more electricity than the national average to generate one dollar of GDP. This is partly due to the region's higher-than-average share of electricity-intensive industries such as primary metals, textiles, paper and other wood products, and chemicals.[3] The commercial and residential sectors in the South are also more electricity-intensive than the rest of the nation, by 33% and 27%,

[2] These intensities are lower when Texas and Oklahoma data are included (the drop in industrial intensity is particularly notable), but the South is still more electric intensity than the rest of the country even with these two states included.
[3] Table A-2 and A-3 in Appendix A show the composition of electricity-intensive industries in the US and their share in southern states' Gross State Production (GSP).

respectively. This is partly because buildings in the South rely more on electricity and less on natural gas for space heating than the rest of the nation as a whole (Table A-4a, Appendix A). Southern states also experience warmer temperatures – as reflected in their larger cooling degree days (CDDs) – and as a result consumers use more electricity for space cooling than the rest of the nation as a whole (Table A-4b, Appendix A). Considering all of the states in the South with significant cooling loads and electric home heating, residential electric intensity is particularly high in Alabama and South Carolina (with intensities of 0.16) and Mississippi (at 0.17), compared with Texas (at 0.09). Further evidence of high residential electricity intensity in the South is illustrated by Arizona with CDDs exceeding 5,000 in 2012 and 58% electric home heating, but with a residential electricity intensity of only 0.12. Section 5 provides evidence that the high electricity intensities in the South also reflect inefficient end-use equipment, systems, and practices as well as the absence of key energy-efficiency policies.

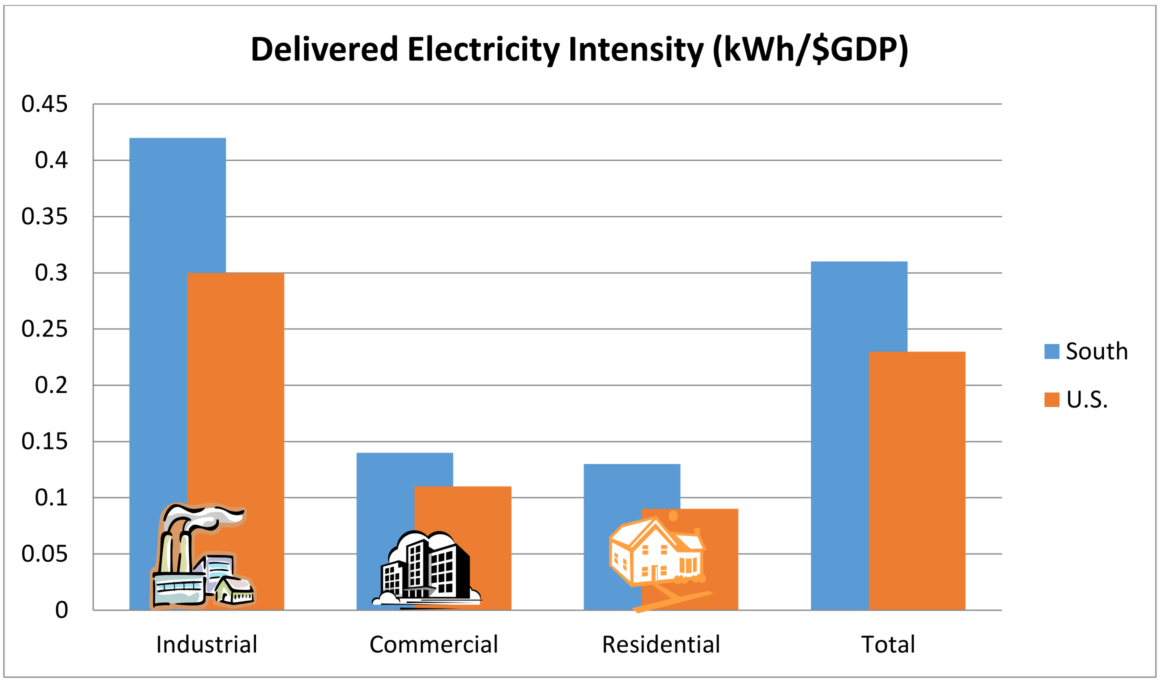


Figure 3. Electricity Intensity by Customer Class in the South and the US in 2012
(Notes: The South excludes TX and OK. State data and data sources can be found in Appendix A.)[4]

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[4] The gross regional product (GRP) of the South (excluding TX and OK) was approximately $3.90 trillion in 2012. Most of this GRP was affiliated with the commercial sector ($3.1 trillion), which is defined as the South's GRP minus the sum of the economic activity associated with the industrial and transportation sectors. $0.75 trillion of economic activity was affiliated with industrial activity, defined as agriculture, construction, manufacturing, and mining. The economic activity associated with the residential sector is assumed to be the total GRP of the South (Bureau of Economic Analysis: Gross Domestic Product by State, http://www.bea.gov/regional/). Electricity intensity is calculated as the delivered electricity consumed by each sector divided by the economic activity associated with that sector. The electricity consumption and economic activity data come from:

http://www.eia.gov/state/seds/seds-data-complete.cfm?sid#Consumption
http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=1&isuri=1.

Historically, coal has dominated electricity production in the South, but its share has declined rapidly in the past several years to 38% of generation in 2012 (36% when Texas and Oklahoma are included).[5] Reflecting the diversity within the South, West Virginia and Kentucky have particularly high levels of coal generation (96% and 92%, respectively), while Florida uses more natural gas than coal and South Carolina's generation mix is dominated by nuclear power.[6] In contrast to its coal use, the South depends less on renewable sources such as wind, solar, biomass and hydro power for electricity generation than any other region, with only 5.8% of its electricity generation coming from renewables (or even less, 4.6% when Oklahoma and Texas are excluded) compared with 11.8% nationwide.[7] Some of these differences are explained by the resource endowment of the South. Outside of Texas and Oklahoma, the South currently has only a moderate endowment of wind and solar. Nevertheless, the South still accounts for 32% of the nation's utility-scale and rooftop PV capacity (16% excluding Texas and Oklahoma) and 22% of the nation's wind capacity, primarily located in Texas and Oklahoma.[8]

The South has a diversity of electricity market structures. For instance, Texas has had a competitive wholesale electricity market since 2001 with active day-ahead and spot markets for electricity generation as well as competitive markets for retail electricity for end consumers. Our definition of the South also includes Maryland, which has participated in the competitive PJM market since 1997, with locational marginal pricing since 1998. More recently, Texas has also adopted locational marginal pricing.

Other states such as Georgia and Alabama have vertically integrated firms that own generating assets and are local monopoly providers to consumers that are regulated by public utility commissions. Georgia has a unique transmission system jointly owned with local cooperatives and municipal utilities. Through that system, there is one-time competition to serve new loads above a certain size threshold. In Alabama, competitive requests for proposals (RFPs) are issued for capacity and energy and there are other market-based features (Rossmann, 2014).

The South is also home to the Tennessee Valley Authority (TVA), a federally owned corporation and the largest public power provider in the US It serves 9 million customers across Tennessee, portions of Alabama, Mississippi, and Kentucky, as well as smaller parts of Georgia, North Carolina, and Virginia, serving 155 local power companies and approximately 50 direct-serve customers (Hoagland, 2014).

The South also has a relatively high proportion of end users that purchase their electricity from co-operatives (21% compared to 7% in the rest of the US) than from investor-owned utilities (52% compared to 71% in the rest of the US).[9] Co-ops are generally not regulated by federal or state

[5] Spreadsheet calculation based on EIA data from http://www.eia.gov/electricity/data/state/)
[6] Spreadsheet calculation based on EIA data from http://www.eia.gov/electricity/data/state/). See Table A-6 in Appendix A for details.
[7] Spreadsheet calculation based on EIA data from http://www.eia.gov/electricity/data/state/)
[8] Spreadsheet calculation based on EIA data from http://www.eia.gov/electricity/data/state/)
[9] Data from EIA Form 861 for 2012. Excluding Texas and Oklahoma, the estimates are 22 vs 18% and 62 vs 65%.

regulators in the South, while most municipal utilities are self-regulated by municipal governments. But again, the South is not uniform in this regard, with TVA being self-regulated, and also regulating its 155 municipal and co-op customers.

2. Coal Dominates, but Natural Gas is Rapidly Gaining Market Share

The South has a different electricity generation profile than other portions of the country, but within the region there is also great diversity. The South has seen a dramatic increase in the fraction of electricity generation that has come from natural gas. In 1990, less than 10% of electricity generation was produced using natural gas and 59% used coal compared to 34% of generation coming from natural gas in 2012 and 38% from coal. North of the Tennessee-North Carolina line (and from historic gas supply states), the shift to natural gas is much less pronounced.

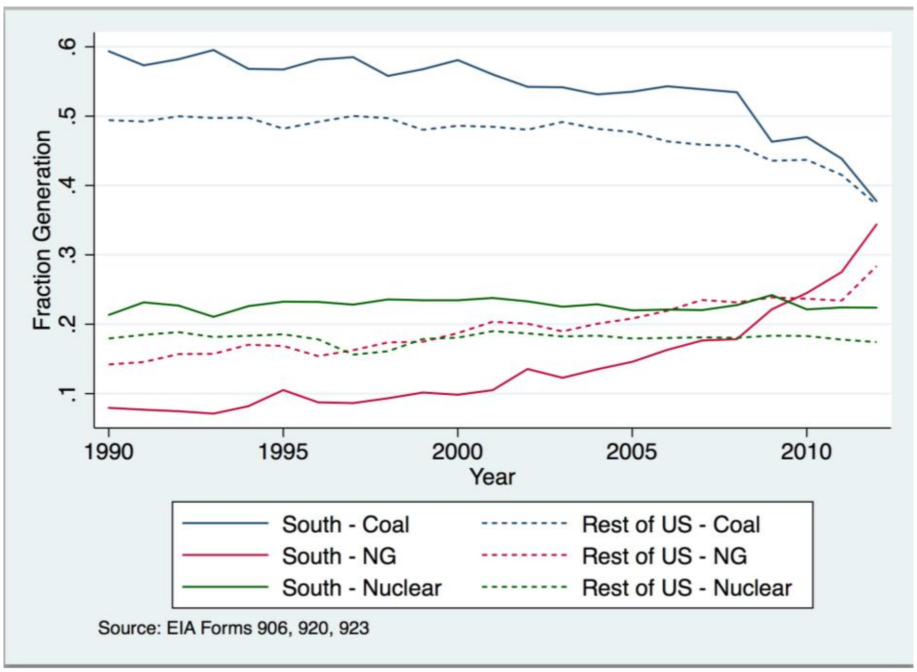

Figure 4. Electricity Generation Mix in the South

Source: Spreadsheet calculations using EIA data from http://www.eia.gov/electricity/data/state/

(Statistics for the "South" exclude Texas and Oklahoma)

This change in generation mix has been motivated in part by the recent fall in natural gas prices (seen below) enabled by horizontal drilling and hydraulic fracturing, which has prompted utilities to add combined cycle generators. While this trend has been true across the country, it has been more pronounced in the South because of the readily available natural gas pipeline infrastructure, its proximity to a historical gas source region, and the region's historic reliance on coal, which is requiring greater environmental clean-up costs.

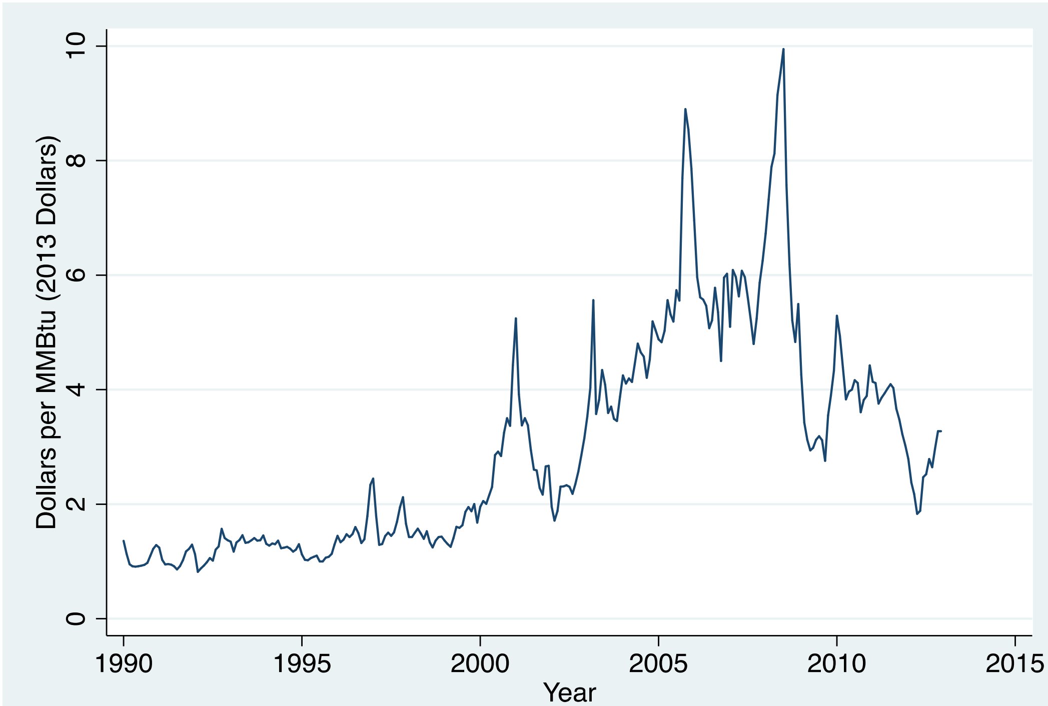

Figure 5. Wellhead Natural Gas Prices

Source: EIA (http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm) deflated to 2013 dollars using Bureau of Economic Analysis consumer price indices

Moreover, this trend toward an increase in natural gas generation is likely to continue as the age of the current coal generating fleet increases and EPA promulgates increasingly strict environmental regulation. Among the regulations that are likely to accelerate the retirement timeline of coal-fired generators are the recently finalized Mercury Air Toxics Standard (MATS), the Cross-State Air Pollution Rule (CSAPR)[10], and some form of carbon dioxide emissions regulation. In June 2014, EPA released draft performance standards for existing power plants under Clean Air Act **§**111(d), which would complement the previously released New Source Performance Standards for new power plants under **§**111(b).

Figure 6 shows the planned retirement of coal-fired generators for 2012-2016, with many of the generators being located in the South.

[10] While CSAPR is not currently a finalized rule, it is likely that some form of more stringent environmental standards for sulfur dioxide and nitrogen oxide emissions, potentially similar to the Clean Air Interstate Rule.

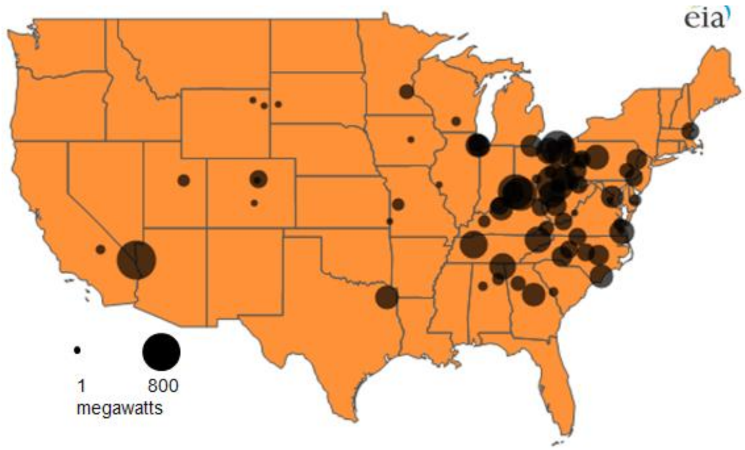

Figure 6. Reported Coal-Fired Generator Retirements, 2012-2016
Source: Union of Concerned Scientists, 2013

In addition to the announced coal-fired generator retirements, there are many generators that may be on the edge of economic viability when the cost of likely environmental regulations is taken into account. According to the Union of Concerned Scientists (2013), most ripe-for-retirement capacity is concentrated in the Southeast and Midwest. Specifically, a total of 23,357 megawatts of coal capacity in Florida, Alabama, Georgia, Mississippi, and Tennessee may soon become uneconomical as well as many other generators in southern states. Coal retirement is a controversial topic. The value of energy security through resource diversification as well as concerns about the high cost of constructing new capacity cause some to question the magnitude of "ripeness" for retirement that is portrayed in the UCS report.

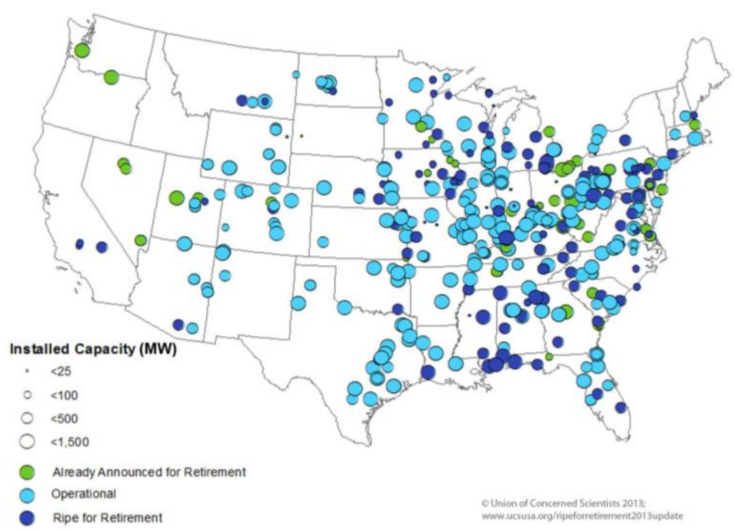

Figure 7. Ripe-for-Retirement Coal Generators Compared to Existing Natural Gas[11]
Source: Union of Concerned Scientists, 2013

[11] Coal-fired generators are deemed ripe for retirement if they would cost more to operate – including the costs of installing any needed pollution controls – than a typical existing cleaner-burning and more efficient combined cycle natural gas plant (NGCC) (Union of Concerned Scientists, 2013).

At the same time that many coal plants are being retired across the South, the Southern Company is building an advanced coal plant in Kemper County, Mississippi, which is likely to become the cleanest coal plant in the world. This first-of-a-kind power plant will use "carbon capture" technology. When completed in 2015, approximately two-thirds of the plant's carbon dioxide will be captured and carried through a pipeline system to be injected into oil drilling operations to enhance the production of crude oil. The plant is located at a Mississippi lignite mine and a CO_2 pipeline system, a fortuitous but unusual combination of circumstances. According to the US Department of Energy, which is supporting the project, the Kemper plant could earn an extra $80 million a year by selling carbon dioxide and other byproducts.[12]

3. The South is Home to All of the Nation's Nuclear Reactor Construction Projects

The South contains the only new nuclear construction in the US: one unit at Watts Bar in Tennessee, two units at Plant Vogtle in Georgia, and two units at V.C. Summer in South Carolina. The concentration of nuclear construction in the South is due in part to the regulatory structure in the South. Since the utilities are vertically integrated and investments in new generating assets are subject to oversight by public utility commissions, firms are able to invest in technologies such as nuclear reactors more readily because they are obligated by their regulatory agencies to look over more extended horizons in making decisions that are in the long-term best interest of customers. This gives the South an opportunity to determine if new nuclear reactors can be constructed in a way that is economically viable and competitive over the long run with other energy sources such as natural gas and renewables. Nuclear power could be constructed to displace coal generators that face aging, economic, and environmental pressures.

In Tennessee, TVA is working to finish the partially completed second Westinghouse pressurized water reactor at its Watts Bar plant. Watts Bar 2 was about 80% complete when its construction was stopped in 1988 following the 1979 Three Mile Island accident. Construction resumed in 2007, with the reactor expected to begin operation in late 2015, with a planned capacity of nearly 1.2 GWe.[13] Watts Bar 2 is likely to be the first new nuclear reactor to come on line in the US this century.

The four units in South Carolina and Georgia were licensed for construction more recently. They will have newer Westinghouse pressurized water reactors, based on the AP1000 design that emphasizes passive nuclear safety and is expected to be more economic to build, operate, and maintain.[14] Vogtle 3 and Summer 2 are expected to be commissioned in 2017, with Vogtle 4 and Summer 3 coming on line one year later in 2018, each with a planned capacity of 1.1 GWe.[15] The new V.C. Summer plant will be owned jointly by South Carolina Electric & Gas Company and Santee Cooper, and the new Vogtle plant will be owned jointly by Georgia Power and Oglethorpe Power Corporation. Nuclear plant construction

[12] http://www.washingtonpost.com/business/economy/intended-showcase-of-clean-coal-future-hits-snags/2014/05/16/fc03e326-cfd2-11e3-b812-0c92213941f4_story.html
[13] "WATTS BAR-2". *PRIS*. International Atomic Energy Agency. June 29, 2013. Retrieved June 29, 2013.
[14] http://westinghousenuclear.com/New-Plants/AP1000-PWR
[15] SCANA (2013). "Nuclear Financial Information".

costs are made more affordable to these investor-owned utilities since some of the costs can be directly passed through to consumers through Construction Work in Progress (CWIP) payments.

The issue of nuclear spent fuel is a major concern for many stakeholders. Used fuel produced by the AP1000 can be stored indefinitely in water on plant sites. Aged used fuel may also be stored in above-ground dry cask storage, in the same manner as the currently operating fleet of US power reactors.[16]

4. Few Southern States have Renewable Requirements Yet Some Have Large Renewable Portfolios

The South generates 5.8% of its electricity from renewable sources, less than the 11.8% national average[17]. Wind power is the largest renewable resource in the South, providing 103.8 billion kWh of electricity in 2012. Oklahoma and Texas contribute over 95% of the wind electricity generation in the South. Hydropower is the second largest source with 34.4 billion kWh of generation, followed by biomass which generated 26.9 billion kWh of electricity in 2012. Solar power has a small presence in the South, generating a little over 0.5 billion kWh, significantly smaller than the other renewable resources. The three census divisions have different renewable electricity portfolios.

- The South Atlantic census division has the smallest renewable electricity generation among the three southern census divisions (Figure. 8). In 2012, 3.9% of the electricity generation in South Atlantic came from renewable resources, more than half of which was from biomass sources. Hydropower is the second largest renewable electricity source, accounting for 40% of the renewable electricity generation. Wind and solar generation have a small presence.
- The East South Central division has the least amount of renewable electricity among the three divisions in terms of kWh electricity generated, but the relative share of renewable electricity is higher in this division than in South Atlantic, with 6.3% of its total electricity generation coming from renewable resources in 2012. Hydro power is the largest renewable source, providing 77% of the division's renewable electricity, followed by biomass. Little wind and solar power is used in the division.
- The West South Central division, which includes Texas and Oklahoma, has the most renewable resources. Renewable resources generate over 51 billion kWh of electricity in 2012, which is over 7.6% of the division's total electricity generation. West South Central has the most wind resource in the South. In 2012, over 40 billion kWh of wind energy was generated in the region, which represents 80% of the division's total renewable energy generation and 6.5% of the division's total electricity generation. Biomass and hydropower account for almost the entire remaining 20% renewable electricity with solar contributes less than 1%.

[16] http://en.wikipedia.org/wiki/AP1000#cite_ref-35
[17] Spreadsheet calculation based on EIA data from http://www.eia.gov/electricity/data/state/)

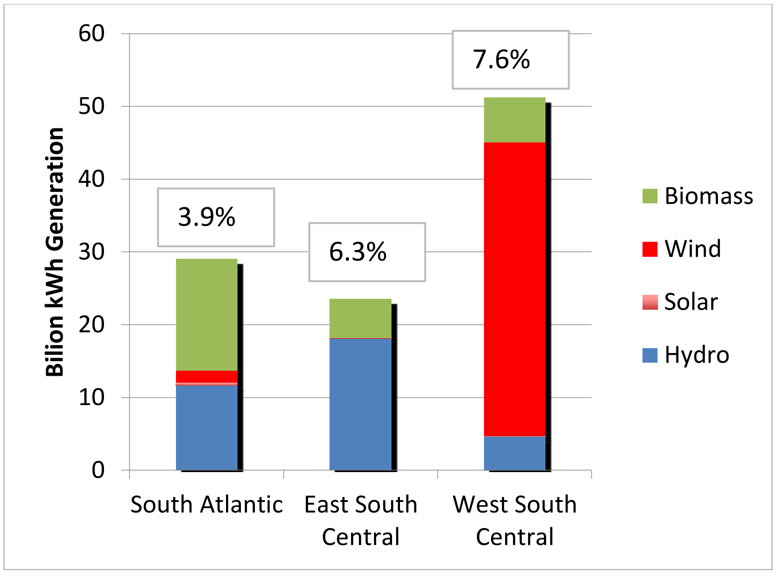

Figure 8. Renewable Electricity Generation in the South in 2012

Sources: Spreadsheet calculations using EIA data from http://www.eia.gov/electricity/data/state/

Statewide renewable electricity standards (RES) are one of the strongest policy instruments supporting renewable power in the US to date. An RES is a legislative mandate requiring electricity suppliers (often referred to as "load serving entities") in an area to employ renewable resources to produce a certain amount or percentage of power by a fixed date. Typically, electric suppliers can either generate their own renewable energy or buy renewable energy credits. This policy therefore blends the benefits of a "command and control" regulatory paradigm with a market-oriented approach to environmental protection.

There is no universal definition of a renewable resource. Eligible sources typically include wind, solar, ocean, tidal, geothermal, biomass, landfill gas, and small hydro. Solar water heaters qualify as renewable resources in some states (such as North Carolina and Texas), but are disallowed in other states (such as New Mexico and California). Several states have expanded the scope of their qualifying energy resources to include energy efficiency, and some of these allow CHP and other technologies that re-use waste heat (Figure 9). North Carolina was one of the first southern states to enact an RES, requiring that by 2021 utilities generate 12.5% of their electricity from renewables, with CHP and energy efficiency being allowed to meet up to 25% of the quota. The Texas quota calls for 5,880 MW of renewables by 2015 and 10,000 MW by 2025 (Figure 9).

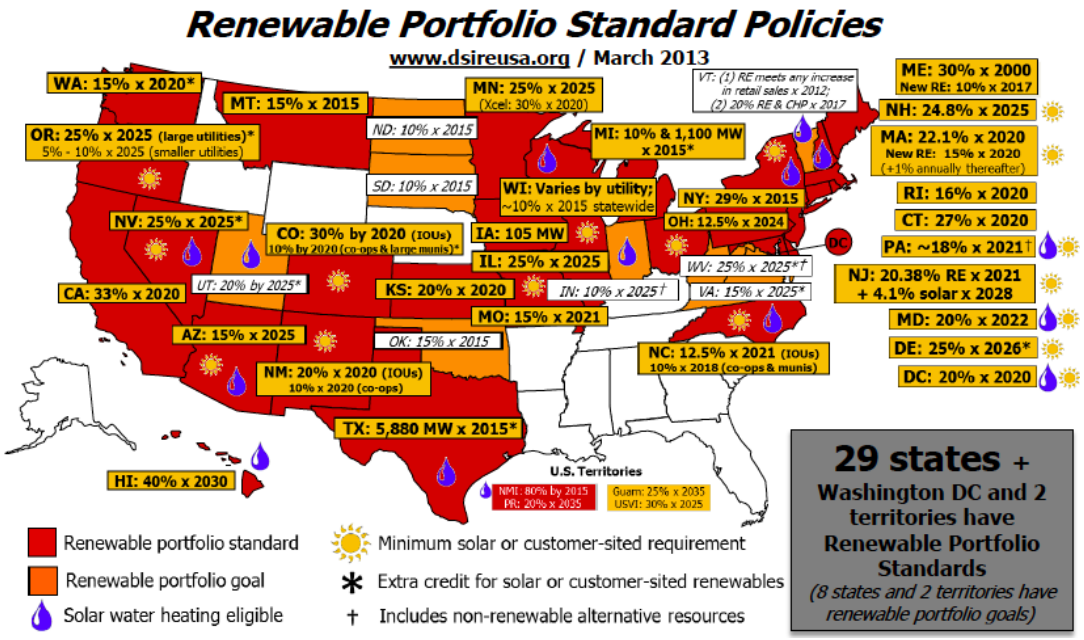

Figure 9. Renewable Portfolio Standards
Source: DSIRE, http://www.dsireusa.org/

4.1 The South Has Ample Biomass Resources, but Biopower is Not Growing

Biomass resources are abundant in the South (Figure 10).

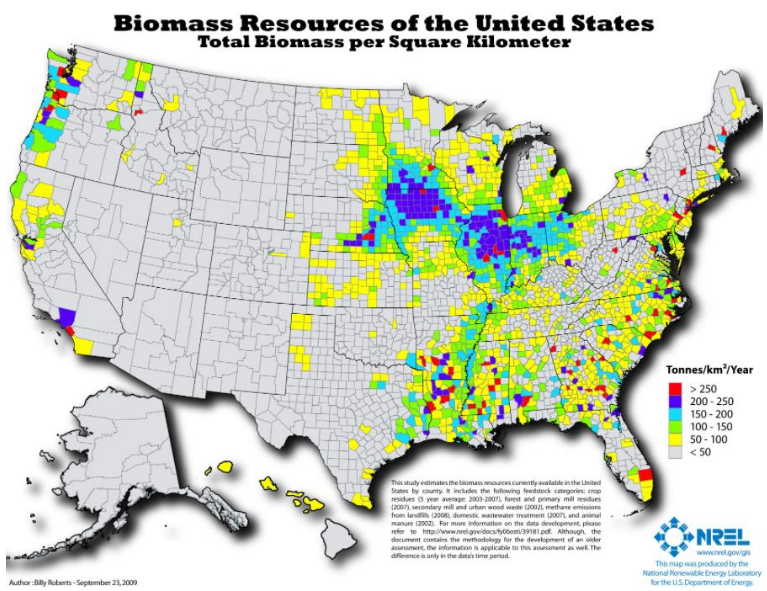

Figure 10. Biomass Resources of the US
Source: http://www.nrel.gov/gis/images/map_biomass_km2.jpg

As shown in Figure 11, the lowest cost biomass resources in Georgia are agricultural residues and forest residues (Levin, Thomas, & Lee, 2011). Unmerchantable timber represents another large and relatively low-cost biomass resource. While resources might be available, the industrial boiler MACT (maximum achievable control technology) rule and current low prices for natural gas present significant challenges to biomass cost-effectiveness. In addition, uncertainty regarding the net CO_2 emissions from biomass combustion affects its potential treatment as a low greenhouse gas option (Thomas and Liu, 2013).

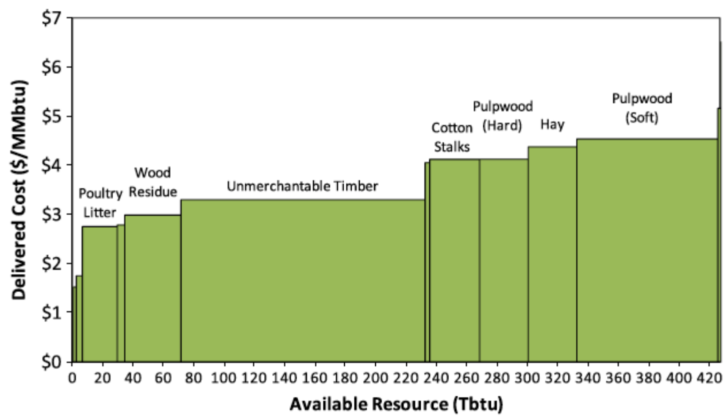

Figure 11. Biomass supply curve for Georgia
Source: Levin et al., 2011

Generation of electricity from biomass can be from dedicated biomass power plants, biomass cogeneration facilities, facilities that use a mix of biomass and fossil fuels, facilities that generate electricity from landfill gas, and facilities that produce electricity from municipal waste. Considering just the grid-connected utility generation, as of 2010 in the South there were:

- 41 dedicated bioelectricity facilities with a total capacity of 836 MW, about half of which are cogeneration facilities in the pulp and paper and other biomass industries, and with additional facilities coming online in the near future,
- 55 municipal solid waste power plants with a total capacity of 719 MW, and
- 146 landfill gas facilities with a total capacity of 253 MW.

Altogether this is a total of 1.8 GW of biomass grid-electric capacity in the South. In addition there are facilities that use a combination of biomass and fossil fuels (ORNL, 2012).

The locally used generation of electricity from biomass (as at pulp and paper mills) is approximately twice the magnitude of grid-integrated bioelectricity. Net generation from biomass was 15.3 billion kWh (2% of total generation) in the South Atlantic region, 5.4 billion kWh (1.4%) from the East South Central region, and 6.1 billion kWh (0.9%) from the West South Central region from 3 GW of generation. Most of this was generated and used in the pulp and paper, wood products, and agricultural industries (EIA, 2013).

The South is an exporter of biomass pellets for production of electricity internationally. Major producers of wood pellets include Georgia Biomass in Waycross, Georgia (1.7 million green tons of wood annually), Green Circle Bio Energy in Cottondale, Florida (1.3 million green tons per year), and German Pellets Texas in Woodville, Texas (1.3 million green tons per year). Overall more than 9 million green tons of wood per year are made into pellets in the south and exported (Forisk, 2014). This is enough to produce 1 GW of electricity.

Landfill gas is a significant source of electricity from biomass; these facilities provide useful electricity while preventing the release of methane, a potent greenhouse gas, to the atmosphere (US EPA, 2014).

Cofiring of biomass in existing coal-fired power plants is another low-cost approach to generating electricity with biomass and biomass can generally be accommodated at the 5-10% level. Many European coal-fired power plants have adopted co-firing, and some coal plants in the South have co-fired with biomass.

4.2 Wind Power Has Seen Little Development in the Southeast

Wind resource is limited in the South. Wind speed is one indicator used to measure the quality of wind resource. According to NREL, areas with annual average wind speeds around 6.5 meters per second or greater is considered as suitable for wind development. The average wind speeds in most of the area in the South Atlantic and East South Central Census range from 4 to 5.5 meters per second. West South Central has better wind resources; large areas in Texas and Oklahoma have wind resources measured at 6.5 to 8.5 meters per second (NREL, 2012). As a result of the good wind resource, nearly half of the wind power capacity in the US is in Texas and Oklahoma (Figure 12).

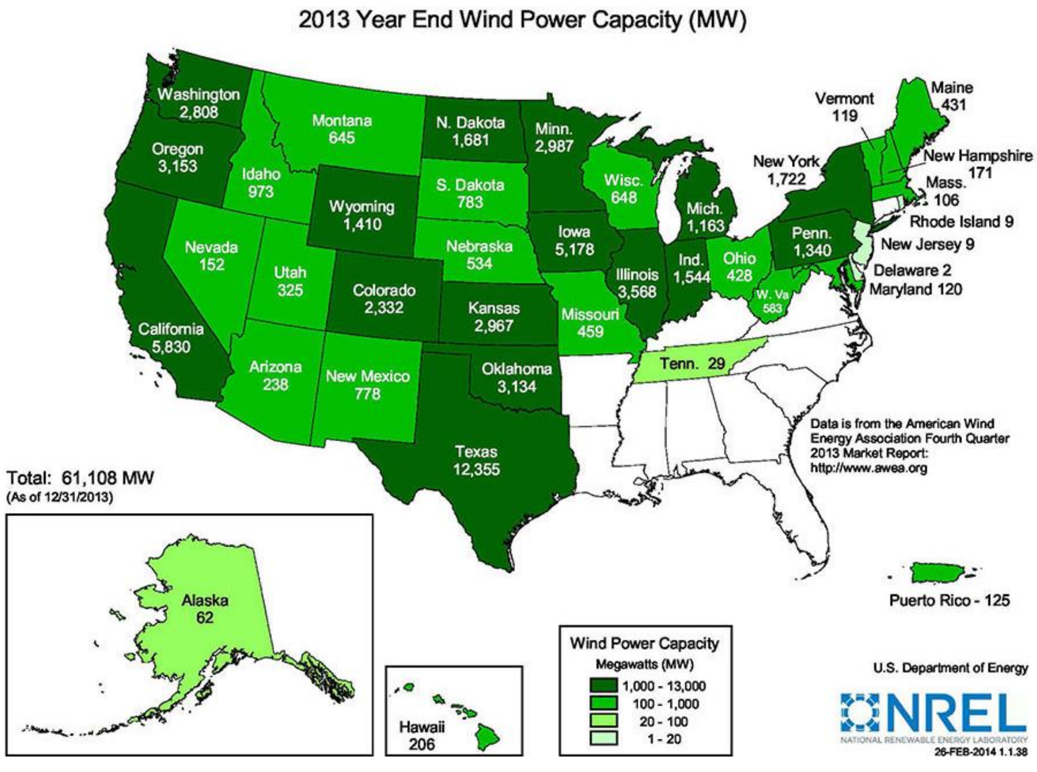

Figure 12. Wind Power in the US
Source: http://apps2.eere.energy.gov/wind/windexchange/wind_installed_capacity.asp

In 2012 wind turbines generated 1.6 billion kWh (0.01% of total generation) in the South Atlantic region, 0.047 billion kWh (~0%) in the East South Central region, and 40.4 billion kWh (7%) in the West South Central region (US DOE, 2013). Wind energy generation has been growing rapidly in the past several years. Alabama Power has entered into power purchase agreements with wind energy generators in Oklahoma and Kansas for a total of 404 MW, TVA has power purchase agreements (PPAs) with Midwest providers in addition to the wind capacity it built in Tennessee, and Georgia Power has a PPA with a wind energy generator in Oklahoma for 250 MW scheduled to come on line in 2016 (Ratcliffe, 2013).

There is substantial potential for wind energy in the south, including generation within the region and transmission from nearby states. Figure 13 shows the potential supply of wind energy that could be generated within the SERC region (Southeast Electric Reliability Council) and that could be generated within the neighboring regions and transmitted to SERC. The figure was generated taking into account the within-region and neighboring-region overall electricity demand; transmission costs are included.[18] The blue line in the figure shows that at a generation cost of about $0.08 kWh, there are about 5 GW of wind capacity available in the SERC region; at a cost of about $0.09/kWh the availability of wind is substantially larger, both from wind generation within SERC and from generation and transmission from neighboring regions. The red line shows potential imports from the southwest power pool (SPP) region[19], which includes Oklahoma; already Georgia and Alabama are sourcing Oklahoma wind energy. The green line shows potential imports from the MRO (Midwest reliability organization) region; MRO states are to the northwest of the south[20] yet their ability to produce low-cost wind energy provides potential to export wind energy from, for example, Iowa in MRO to Kentucky and Tennessee, in the northwest portions of the south (Choi, Kreikebaum, Thomas, & Divan, 2013). There is also substantial wind energy potential in Texas.

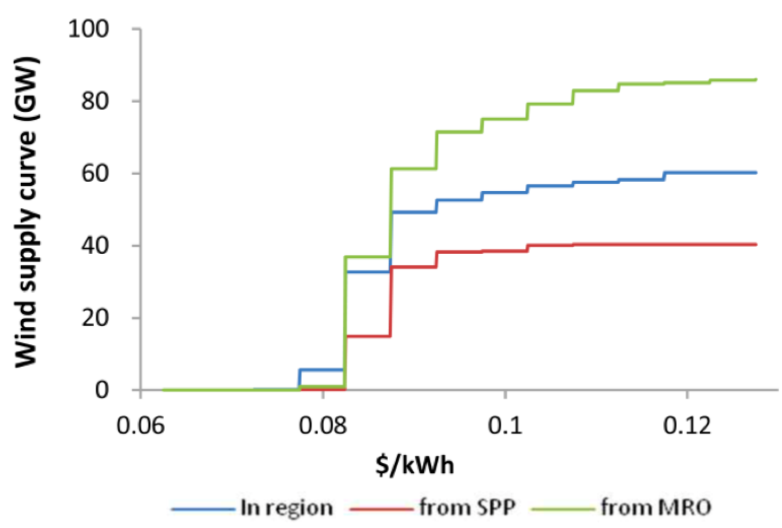

Figure 13. Wind Supply Curve in the SERC region
Source: Choi et al., 2013

[18] SERC includes MO, IL, NC, VA, AL, TN, GA, SC, MS, KY, AR, LA, and western FL. Note that SERC includes most of the southern states, and also MO and IL, which have significant wind potential, some of which could be transmitted to the states included in the definition of the south used here, as shown in Figure 1.
[19] SPP includes KS, OK, and portions of NM, TS, AK, LA, MI and NE
[20] MRO includes MN, ND, NE, MT, SD, IA, and WI.

Off shore wind is currently being assessed in the Southeast, but no off-shore wind production has come on line yet in the US

4.3 Hydropower: Low-Cost Baseload Option with Some Small-Scale Expansion Opportunities

Hydropower currently operates as a low-cost baseload and peaking resource that is particularly well developed in Tennessee, Alabama, and North Carolina. Today, net generation from hydropower is on a level with generation from biomass in the South. Hydropower generation is 11.7 billion kWh (1.5% of total generation) in the South Atlantic region, 18 billion kWh (4.7%) in the East South Central region, and 4.6 billion kWh (0.7%) in the West South Central region (US DOE, 2013). There is potential for expansion of low power (less than 1 MW) or small hydro (between 1 and 30 MW) projects. The southern states with the greatest additional low and small hydropower potential are Tennessee (which could increase hydropower by 61%), Arkansas (146%), Kentucky (135%), West Virginia (356%), and Alabama (41%) (US DOE, 2006).

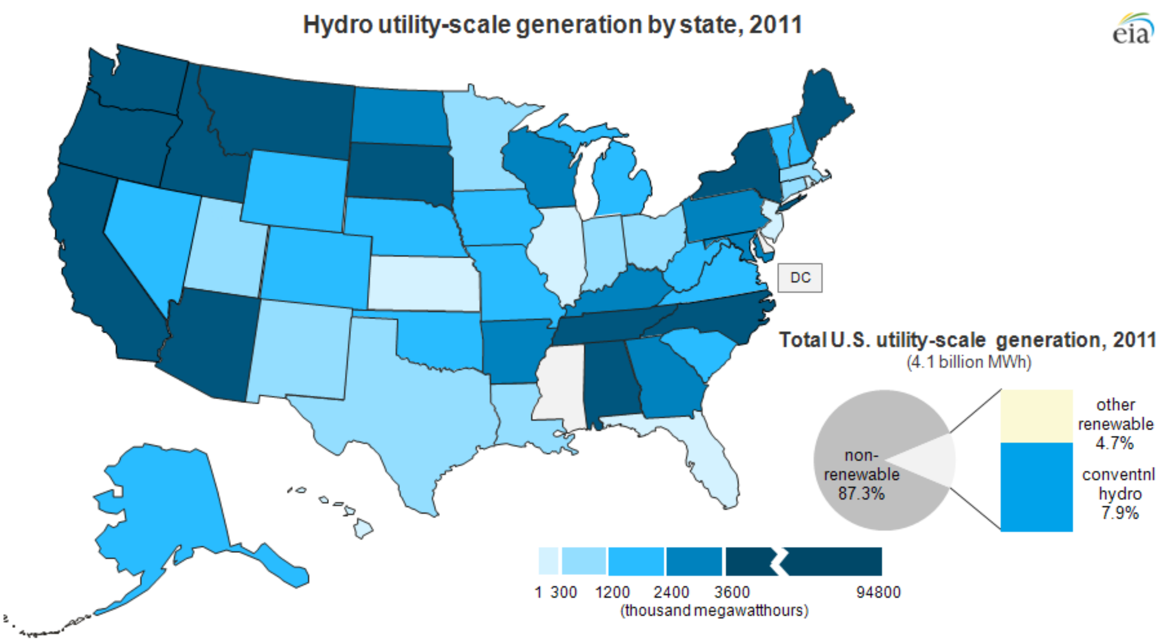

Figure 14. Hydro Utility-Scale Generation by State, 2011
Source: EIA, 2012

4.4 Solar Power: High Relative Costs in the South and Lower Market Penetration

As one of the focal points of this report, this section provides considerable detail on the cost-effectiveness, policies, and state of this renewable power option.

Cost of Solar is Declining. Unlike other renewable resources, the cost of solar photovoltaics (PV) has been declining rapidly in the US (Figure 15). However, grid parity has not been achieved in the South in part because the of the relatively low electricity prices enjoyed by southerners. US PV module prices have dropped from more than $3 per W in 2008 to less than $1 per W in 2012. This is due in part to the significant reduction in prices for solar PV panels manufactured in China, which is now the dominant producer of solar PV equipment.

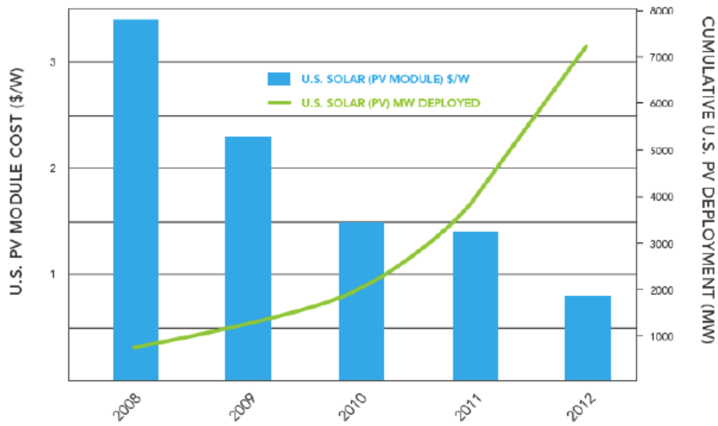

Figure 15. The Cost of Solar Photovoltaics
Source: US DOE, 2013

At the same time solar costs are not uniform nationwide; in particular, they are higher in the South than the rest of the US. The residential solar system costs shown in Figure 16 are the costs after state and federal subsidies are taken into account. In some states (such as Louisiana, Maryland, Massachusetts, New Jersey and New York), a home solar system can be purchased for less than $10,000.

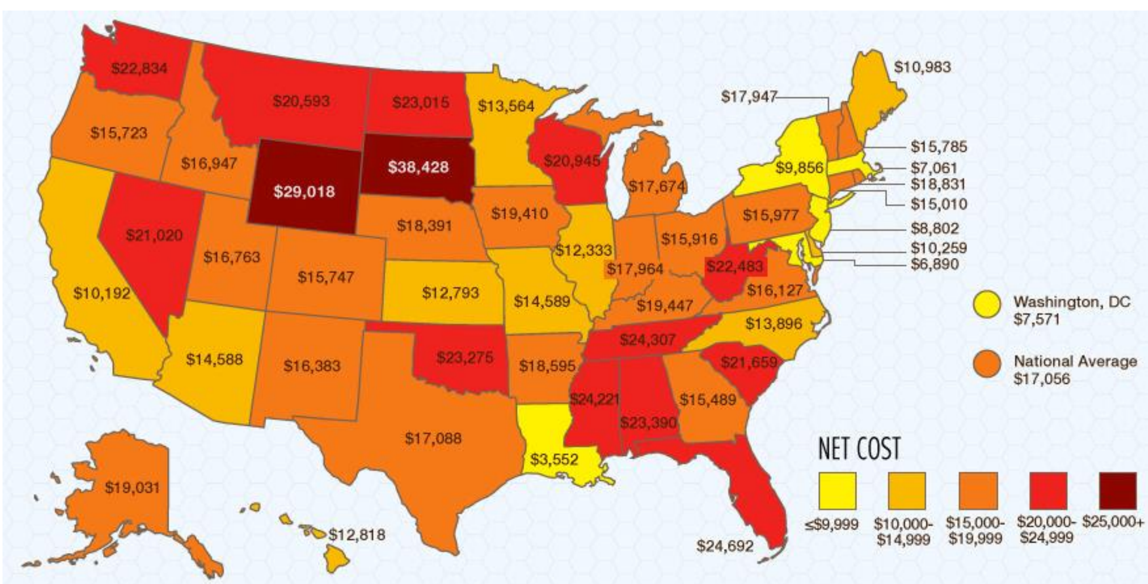

Figure 16. US Homeowner Solar Costs across the US in 2011
Source: http://www.newsilike.in/wp-content/uploads/2012/04/how-much-does-solar-cost.jpg

Based on data from the Solar Energy Industry Association (SEIA), there were 4,751 MW of new solar PV capacity added to the US in 2013, a 41% increase in capacity since 2012 (Solar Energy Industry Association, 2014). This has made the percentage of new electrical energy generation capacity by solar PV second only to that by natural gas since 2012. In terms of Annual PV capacity additions, the leading state was California, followed by Arizona (Solar Energy Industry Association, 2014). However, North Carolina, was ranked third in the US for new installation capacity, driven mainly by utility scale systems (Figure 17). Georgia ranked seventh for new installed capacity, again being driven by utility scale systems. In terms of cumulative capacity, California ranks first, but North Carolina is the fourth ranking state in total installed capacity.

System level costs in the US have continued to drop, on the order of 14% for utility scale systems in 2013. The same magnitude of declines is being seen worldwide.[21] These declines are continuing to help drive the market demand for solar PV systems (Greentech Media & Solar Energy Industry Association, 2014; Solar Energy Industry Association, 2014). In 2013, Georgia saw an increase of 762% in installations (91 MW) while North Carolina saw 171% increase in installation (335 MW) (Greentech Media & Solar Energy Industry Association, 2014; Solar Energy Industry Association, 2014) This new growth in both Georgia and North Carolina could signal the emergence of new solar PV opportunities in the Southeast (Figure 17). Georgia Power's renewed Advanced Solar Initiative could further increase the solar PV capacity in the state.

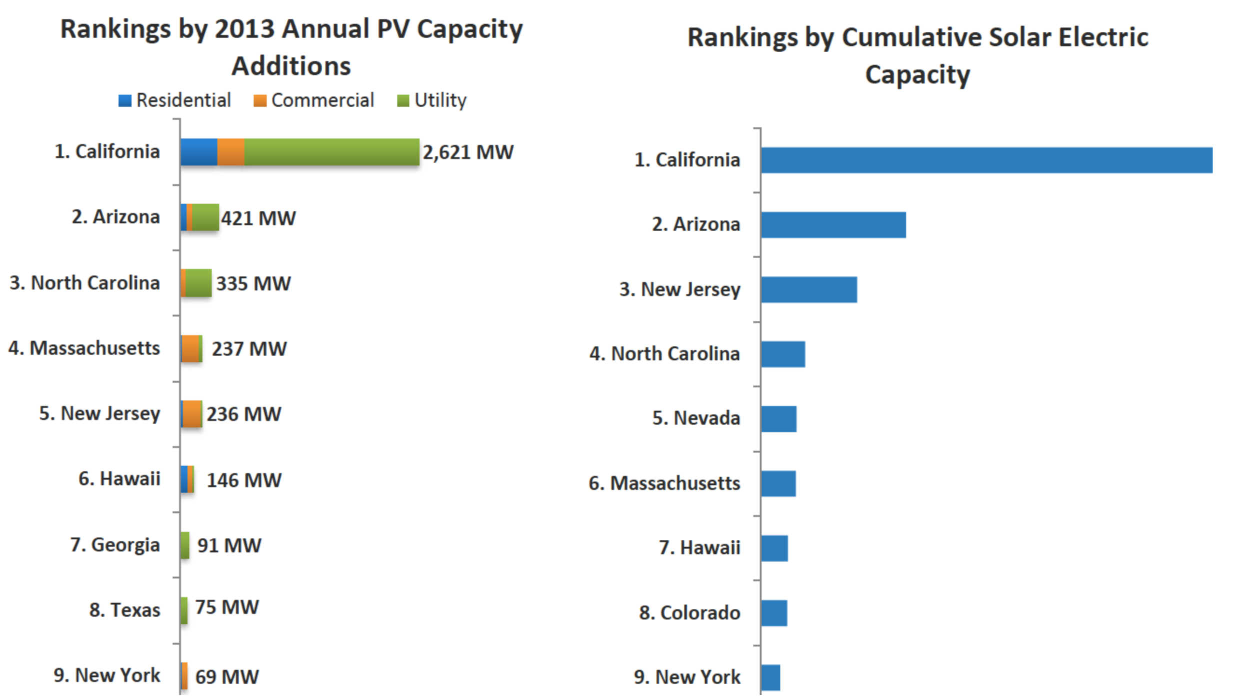

Figure 17. Top States with Newly Installed PV Capacity in 2013 and Cumulative PV Capacity
Source: Solar Energy Industry Association, 2014

[21] December 2013 http://www.pv-magazine.com/investors/module-price-index/#axzz3EgKA9SFq

North Carolina is the only Southeastern state that ranks near the top in additions and total capacity in the US (Solar Energy Industry Association, 2014). North Carolina and Georgia lead the South's effort in installing solar.

Nationwide, 19 states have 45 different tax incentive programs for distributed solar (Appendix B Table B-1). Among the 45 programs, 15 of them exist in 8 Southern states (Florida, Georgia, Kentucky, Louisiana, Maryland, North Carolina, Oklahoma, and South Carolina), a number that is comparable to the South's share of national GDP and population (the south accounts 35% of the US GDP and 36% of the population). The South has more tax incentive programs than rebate programs. Only 2 Southern states and Washington D.C. have in total 4 rebate programs for distributed solar, compared to 16 programs in 11 non-southern states. Delaware and Washington D.C. each have one rebate program and Maryland has two. The lower number of solar tax incentive and rebate programs in the South, compared to the rest of the nation, combined with few state level RPS, indicates that the South has less policy support for distributed solar (Marilyn A Brown, Gumerman, Sun, Kim, & Sercy, 2012; Matisoff, 2013).

While the cost of modules has been on a steady decline, a major driver in the reduction of solar PV system is the need to address the "soft costs" associated with solar PV systems. Soft-costs include (a) customer acquisition costs, (b) permitting, inspection, and grid interconnection, (c) labor for installation, and (d) financing (Ardani & Seif, 2013).[22] In 2010, US PV soft costs were $3.32/W for a 5-kW residential system and $2.64/W for a 250 kW commercial system. In general, this represents nearly 50% of the total installed costs for residential ($6.60/W) and commercial ($5.96/W) systems (Figure 18). These values far exceed DOE Sunshot goals of $0.65/W soft-costs for a residential system and $0.44/W for a commercial system, resulting in total installed system costs of $1.50/W and $1.25/W by 2020 (Ardani & Barbose, 2012; Ardani & Seif, 2013; Barbose, Darghouth, Wiser, & Seel, 2012).

Thus, aggressive measures would be required to reduce the soft costs and make the costs of installation of PV systems more attractive, especially in the South where the cost of electricity is currently low compared to other regions of the country. Design tools and simplifying PV systems can help to reduce installation costs making it more attractive to the consumer. In terms of permitting, inspection, and interconnection, regulatory changes could reduce the costs of permitting and registration. Countries such as Germany have reduced soft costs significantly through means like streamlining the permitting and registration processes in an online submission, designing integrated racking system, and using better installation techniques. As a result, the average soft cost in Germany is only 27% of that in the US (Morris, Koben, Goodman, & Seif, 2013). In the US, the permitting, inspection and interconnection process often requires multiple inspections and design reviews, engineering drawings, building permits, and electrical permits, which add layers to the soft costs for PV installation. Studies have found that such regulatory demands are high and expensive and they present a barrier that deters installers from operating in certain areas (Sunrun, 2011; Tong, 2012; Wiser & Dong, 2013). States like Vermont, Colorado, New York, California, and Washington have innovative programs aiming to lower the regulatory barriers to permitting. However, none of the southern states has similar programs. In 2010, the labor costs for installing a PV rooftop system was $0.59/W, nearly $0.07 below the Sunshot 2020 targets for residential systems (Ardani & Seif, 2013). Thus, streamlining the design of PV systems and making them easier to install while developing tools to assist in optimizing the layout for a rooftop will help in reducing these costs.

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[22] http://energy.gov/eere/sunshot/soft-costs

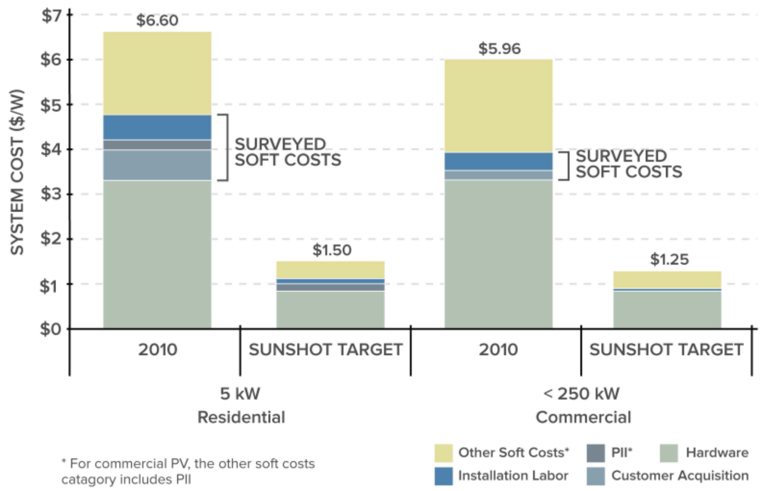

Figure 18. Soft Costs for Residential and Commercial PV Systems
Source: Ardani & Seif, 2013

A recent report from the National Renewable Energy Laboratory provided a look into how policies in various regions of the country have impacted the adoption of solar photovoltaics and looked at states in the Southeast (Steward, Doris, Krasko, & Hillman, 2014). Based on this study, it was found that states enacting effective renewable portfolio standard earlier and having a population in favor of renewable energy technologies are correlated with higher installed solar PV capacity in 2011. Many of the states in the Southeast were designated "Rooftop Rich" or "Motivated Buyers". Rooftop Rich states were characterized by having a higher than median technical potential for rooftop PV systems, but lower than average median income and low electricity prices that impacted the adoption of the technology. In general, these states have solar resources but lack economic motivators to push the technology. Motivated Buyers have less than the median technical potential for rooftop solar PV, but have higher than normal interest due to high electricity prices. States with longer history of renewable portfolio standards and solar set-asides have the largest increase in solar installed capacity (Palmer, Paul, Woerman, & Steinberg, 2011; Yin & Powers, 2010). In addition, states that allow third party ownership and favorable net metering also had larger installed PV capacity in 2011.

As an example, the state of North Carolina which is designated a Rooftop Rich state, is leading the Southeastern US in installed PV capacity in spite of having one of the highest installation costs for residential systems, around $6.60/W. However, North Carolina passed a series of policies between 2007 and 2012 to foster renewable energy adoption in the state, which led to their current leading position in the Southeast. These policies included set-asides for PV, property tax exemptions, 35% personal and corporate tax exemptions, and effective net metering policies. This is a clear demonstration of how renewable electricity standards and policies can impact the adoption of a technology even in states where there are unfavorable economic conditions.

It should also be noted that land requirements for utility-scale solar PV in the Southeast are typically higher than in other places in the US except for the Northeast and Northwest. The amount of land required is a function of solar resources, solar cell efficiency and tracking technology. Compared to the Southwest and a large part of the west coast where solar insolation is abundant, the South is the next most solar abundant region with 3 of the top 10 states in terms of the Sun Index, and 10 of the top 20 states. (See Table B-2, Appendix B). Therefore, to generate the same amount of electricity from solar power, the South requires larger landmass. Previous studies have shown that it requires 5.56 acres/GWh/yr for energy production in the Southeast (based on a fixed axis system in Jacksonville, FL) when compared to only 4.23 acres/GWh/yr in the West (based on a fixed axis system Alamosa, Co) (Ong, Campbell, Denholm, Margolis, & Heath, 2013). Again, policies that are favorable to property taxes and other aspects of land usage can compensate for the increased land required for PV systems in the Southeast.

Net Metering Policies are Variable across the South. Net metering was pioneered in the US in the 1980s. It allows for consumers with renewables to use electricity when needed while contributing excess power to the grid. Net metering was promoted by the Energy Policy Act of 2005; it mandates that utilities pay avoided cost (defined in some states as the wholesale cost for electricity) when buying back renewable electricity from customers with renewable generators. Net metering was established in Georgia by the Georgia Cogeneration and Distributed Generation Act of 2001; it sets a cap of 10 KW for residential PV systems and 100 KW for commercial and industrial PV systems (Figure 19).

In contrast, TVA has developed a "dual meter" policy for distributed generation resources. This allows a true determination of the amount of onsite generation produced and allows for a business transaction to purchase the amount of generation produced at an appropriate value. TVA's Generation Partner program started at a 12 cent per kWh above retail rate---almost 21 cents per kWh as a program incentive to stimulate the market in TVA's region. The Green Power Providers program replaced Generation Partners reducing production incentive payments to 9 cents above retail rate, or about 18 cents per kWh in 2013 and for calendar year 2014, this program is paying 4 cents above retail rates or about 14 cents per kWh. System installed costs to customers continues to decline through technology and productivity, so incentives will be reduced even more in the coming years and is looking to transition to a "market based" program as some point in the future (Hoagland, 2014).

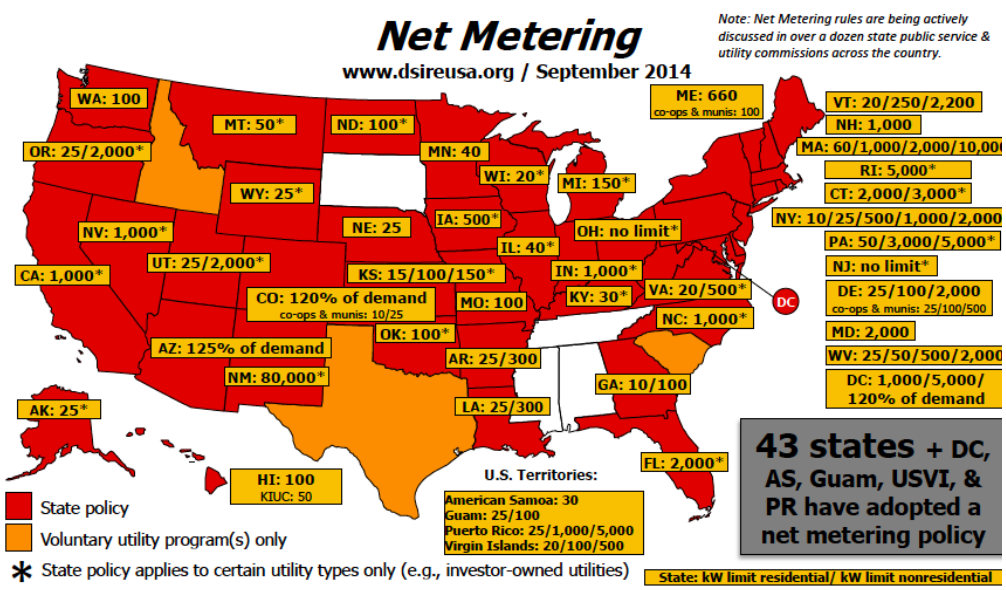

Figure 19. Net Metering in the US in 2013

(Numbers given are the maximum system size, in kW, residential/commercial/industrial)

5. Large Energy Efficiency and Demand Response Opportunities in the South

5.1 Energy Efficiency

In addition to the high electricity intensity ratios discussed in Section 1, other indicators of energy inefficiency come from examining appliance sales data, expenditures on energy efficiency programs, national rankings of state energy efficiency policies and performance, and an assessment of key energy policies.

Sales data suggest a low market penetration of energy-efficiency products in the South. For each of the ENERGY STAR appliances with sales data that are tracked by EPA – air conditioners, clothes washers, dishwashers, refrigerators, and water heaters – the South has market penetration rates that are lower than the national average, as shown in Table A-5 (Brown et al., 2012).

As shown in Table A-7, utilities in southern states spent $7 per capita on electric efficiency programs in 2012, while the average expenditure nationwide (including the South) was $19 per capita.

The American Council for an Energy-Efficient Economy (ACEEE) has ranked most southern states amongst the lowest third in the nation based on their energy efficiency policies and performance (Figure 20). A state's ranking is based on ACEEE's assessment of the programs and policies pursued by the electricity providers in the state, the state's transportation policies, building efficiency codes and compliance, CHP policies, appliance and equipment standards, and state government-led initiatives around energy efficiency (Downs et al., 2013).[23]

Most states in the South rank low on ACEEE's scorecard. Two southern states, however, have routinely outperformed their peers in the South: North Carolina and Florida. In addition, the 2013 ACEEE's State Energy Efficiency Scorecard recognized Mississippi as "most improved" for passing comprehensive energy legislation that included energy efficiency measures such as building energy codes for commercial buildings and public-owned buildings.

[23] http://www.aceee.org/press/2013/11/massachusetts-most-energy-efficient-

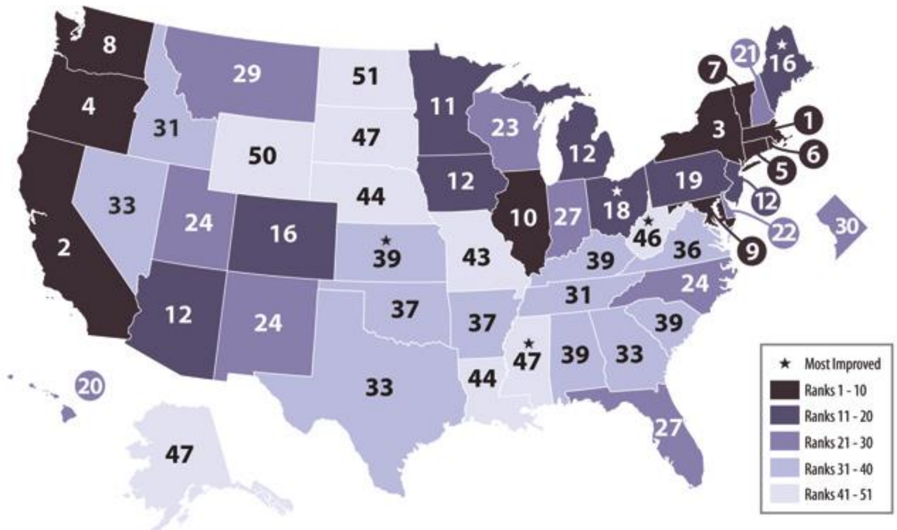

Figure 20. State Energy Efficiency Scorecards in 2013
Source: Downs et al., 2013

The ACEEE scorecard reflects the stringency and enforcement of energy codes for the construction of new buildings (Downs et al., 2013). In the South, four (mostly small) states and DC have commercial building codes that exceed the ASHRAE Standard 90.1-2010, compared to 13 states in total in the nation (OCEAN (Online Code Environment and Advocacy Network), 2014a) and three (mostly small) states in the South and DC have residential building codes that meet the 2012 IECC standard for residential buildings, compared to 11 states nationwide (OCEAN, 2014b). Thus, building codes in the South are only slightly less stringent than the nation as a whole, but ACEEE judges that their levels of enforcement generally fall short of the rest of the country.

As with renewable energy resources where renewable electricity standards act as key policy levers, energy efficiency resource standards (EERS) play a key role in motivating demand-side resource in the US While 20 states across the nation have EERS, only two of these states are located in the South – Delaware and Maryland (Figure 21). The South is home to four of the seven states with energy efficiency resource goals, which set targets but are not binding or enforced by penalties for noncompliance.

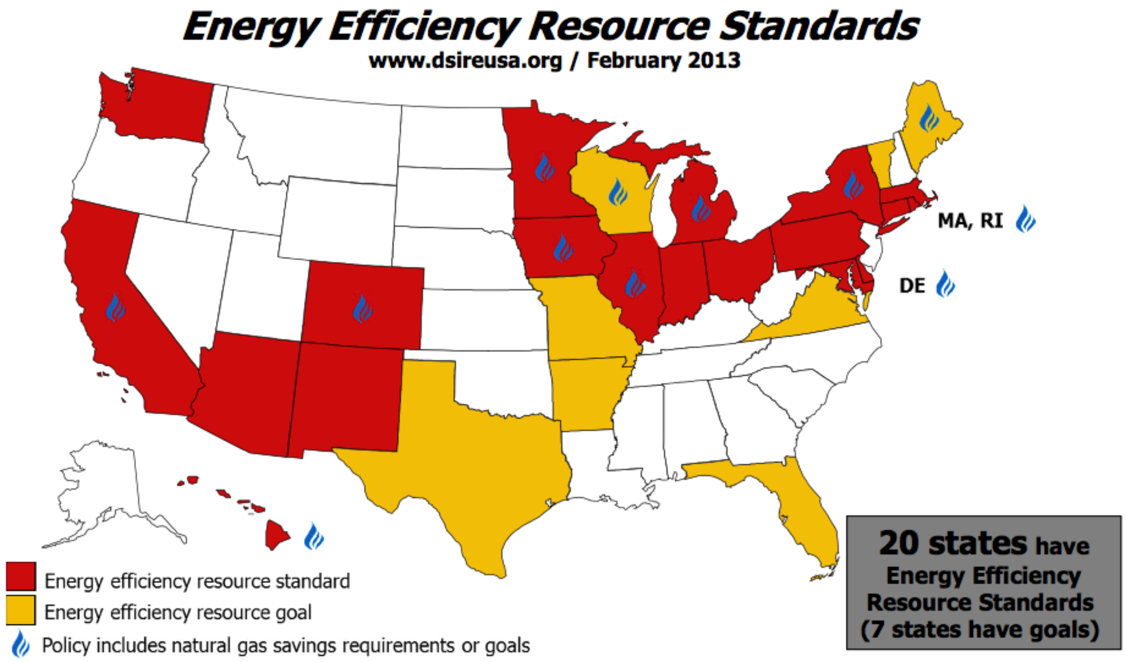

Figure 21. States with Energy Efficiency Resource Standards in 2013
Source: DSIRE http://www.dsireusa.org/

The price charged by a regulated electricity producer is typically set on the basis of an estimation of costs of providing service over some period of time (including an allowed rate of return) divided by assumed sales of electricity over that period. If actual sales are less than projected sales, the utility will earn a smaller return on investment and in fact could fail to recover all of its fixed costs. As a result, current ratemaking procedures encourage utilities to increase electricity sales (i.e., to increase "throughput") and discourage utilities from promoting energy efficiency and distributed generation because they reduce throughput (Lesh, 2009; York & Kushler, 2011). This incentive can be blunted by routine rate adjustments. Included in the category of distributed generation are rooftop solar photovoltaics and cogeneration at commercial and industrial sites, the two technologies examined in particular in this white paper. Some decoupling mechanisms use modest, regular rate reconciliations every year to compensate for under- or over-collection of fixed costs during the previous year (Natural Resources Defense Council (NRDC), 2012).

According to NRDC's definition, by 2013 16 US states had implemented policies to "decouple" electricity profits from sales, up from 9 in 2009. Six other states are currently considering such policies. However, most of the decoupling activities have happened along the west coast, in the Northeast and Midwest region (where electricity prices are relatively high); in the South, only Maryland and DC have decoupling policies in place (Figure 22).

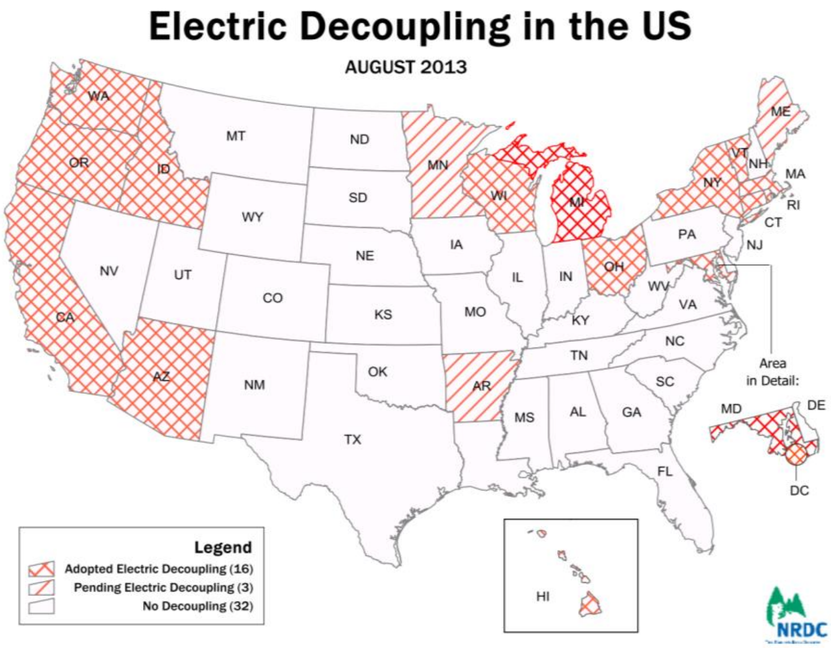

Figure 22. States with Electricity Decoupling
http://www.nrdc.org/energy/decoupling/files/Gas-and-Electric-Decoupling-Maps.pdf

Following an extensive stakeholder participation process, the National Action Plan for Energy Efficiency (NAPEE) (2007) proposed that best practices should include three components – a "three-legged stool" (York & Kushler, 2011). The components are:

- Recovery of program costs
- Decoupling utility profits from electricity sales
- Provision of utility performance incentives.

Based on five case studies, a review of the literature, and expert consultations, Brown, Staver, Smith, & Sibley (2014) identified several general practices used in the Southeast to encourage utilities to invest in energy-efficiency programs. Expensing (rather than amortizing) is the most common approach to allowing utilities to recover program costs. The lost revenue adjustment mechanism (rather than a straight fixed veriable rate) is the most commonly used way of decoupling utility profits from electricity sales. And shared savings based on net benefits from the Program Administrator Cost test (rather than a return on program costs) is the most frequently used way of incentivizing performance.

In Section 410 of the American Recovery and Reinvestment Act, Congress appropriated $3.1 billion for state energy grants, to be released "only if the governor of the recipient state notifies the Secretary of Energy in writing that the governor has obtained necessary assurances" from that state's utility regulators that they will "seek to implement" two conditions for gas and electric utilities over which they have regulatory authority:

- "A general policy that ensures that utility financial incentives are aligned with helping their customers use energy more efficiently;"
- "[T]imely cost recovery and a timely earnings opportunity for utilities associated with cost-effective measurable and verifiable savings."

As a result, states across the country are seeking to implement policies that are aligned with promoting energy efficiency. Since the South possesses significant potential to improve the energy efficiency of its buildings, businesses, and industrial processes (Brown et al., 2010), aligning utility incentives and performance in the South would appear to take on special significance.

5.2 Demand Response

Another rapidly evolving approach to the management of electricity demand is "demand response" (DR). This refers to programs that incentivize electric power customers to change their patterns of consumption (Kathan et al., 2012). DR has been used extensively in industrial and commercial sectors across the South for decades, but today's DR is being transformed by technology and market innovations. Wholesale markets are incentivizing DR to participate in markets, smart grid technologies and dynamic pricing are enabling faster and better control of DR resources, and increasingly system aggregators are enabling smaller entities to participate. Experience has shown that DR can reduce the cost of electricity supply and contribute to system reliability by clipping daily peak loads. During the "snowmaggedon" of January 2014, demand response helped to meet record winter peaks, prevent system outages, and keep costs down in the TVA system and in other electric systems across the South.

5.3 CHP: A Clean Energy Resource with Strong Potential for Expansion

Combined heat and power systems not only offer the benefit of increased overall energy efficiency (Figure 23), but also have the potential to reduce the pollution and water use associated with more traditional energy production. While CHP systems account for less than 10% of the power produced in the US, Denmark is able to operate with more than 50% of its power from CHP systems (Shipley, Hampson, Hedman, Garland, & Bautista, 2008). Factors that differentiate Denmark from the southern US include fuel costs and the need for both spacing heating and space cooling. It is estimated that by having more than 50% of the power production from CHP plants, Denmark has been able to reduce its CO_2 emissions by 7-10 Mt/year when compared to separate heat and power production systems (Hammar, 1999). CHP systems for energy production have been able to gain a high market share in Denmark because of over 20 years of consistent national and local government policies (Brown & Sovacool, 2011). The shift to CHP systems in Denmark began in the early 1970's because of the oil crisis at the time and progressed through the 1980's and early 1990's because of environmental and climate change concerns. Within the US it has been estimated that implementing CHP systems to meet 20% of projected capacity could reduce projected emissions by 60% (Shipley et al., 2008). Other likely benefits from such an expansion are lower electricity rates across all sectors of the economy and job generation (Baer, Brown, & Kim, 2014; 2015).

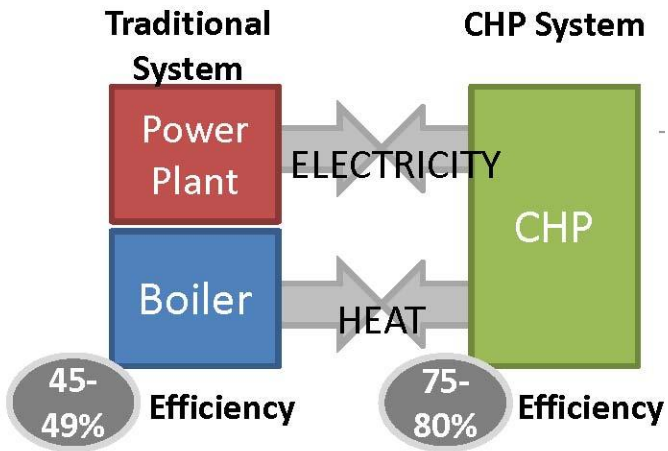

Figure 23. Energy Efficiency Comparison of a CHP System and Centralized Energy System
Source: Brown, Cox, & Baer, 2013

CHP systems can also have significant impacts on the "water for energy" consumed per kWh depending on the range of technologies that make up the system. Most CHP systems can operate on a range of fuels, from coal and natural gas to biofuels, and some CHP systems do not require water for cooling. This means the water for energy impacts are negligible, making the water savings that much greater when compared to a traditional energy generation system. Nationally, 53% of freshwater withdrawals come from the thermoelectric power sector (Figure 24). Based on estimates for states in the South, Brown, et al. (2010) found that the aggressive adoption of energy efficiency programs in the South could save 8.6 billion gallons of freshwater in 2020 and this could grow to 20.1 billion gallons of conserved water in 2030 (or 45% of projected growth).

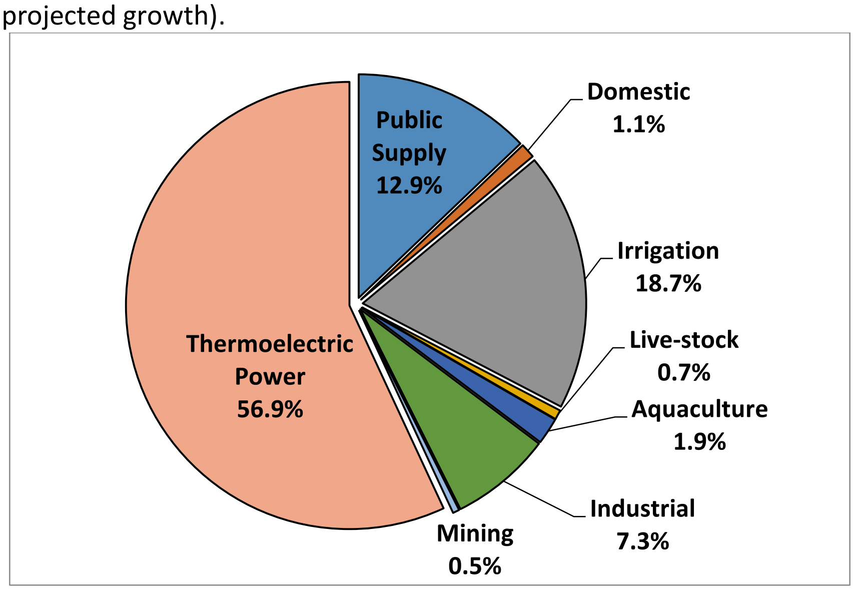

Figure 24. Water Withdrawals in Southern States by Sector
Source: Barber, 2009

Residential, Commercial, and Industrial CHP Potential in the South. In the South, the energy consumed by the residential, commercial and industrial sectors is projected to increase by 18% between 2010 and 2040 (US Energy Information Administration (EIA), 2013). CHP systems are mature technologies and have been implemented at various scales worldwide (Johnson, 2011). They can be used for an individual building, a community, as part of a district heating network, or in an electricity generation system. As most of the technology for CHP systems already exists for CHP systems, the impact of implementing various CHP technology configurations can be analyzed effectively. An example of a CHP configuration is the use of air-cooled microturbines with absorption chillers. The microturbines use natural gas as their fuel to produce heat and electricity, while the absorption chiller converts waste heat from the microturbines to cool the building. Alternatively, a utility-scale combustion turbine or coal plant can be fitted with a waste-heat recovery generator to produce steam for industrial users located near the power production site.

A single 30 kW or 60 kW air-cooled microturbine in a CHP system can reduce the amount of electricity required by a community from a centralized facility by more than 50%. This results in water for energy savings of 66% for a multifamily community and 54% for a single-family community. CHP systems can also be used in conjunction with other renewable energy systems that might suffer from large variations in output on a day-to-day basis. An analysis of a solar PV and a CHP system for 81 homes in a residential community in Phoenix, Arizona (Zhang, 2013) found that a joint CHP and solar PV system could meet the community's electricity requirements, and that the existing natural gas infrastructure could support the CHP system.

The Perkins & Will office building located in Atlanta, GA, illustrates the commercial application of a CHP system by a global design firm focused on sustainability. The renovated office building has earned the highest number of LEED points in the northern hemisphere. This is due in part to the implementation of a building CHP system that consists of a microturbine and an absorption chiller. The microturbines are able to supply approximately 40% of the buildings electrical demand and the microturbines along with the absorption chiller are able to meet the heating and cooling requirements of the building (Photo 1).

Photo 1. Perkins & Will Office Building in Atlanta, Georgia, with a Rooftop CHP System

Recent investment trends show a drop in CHP capacity additions following the Energy Policy Act of 2005 (Figure 25). Before EPACT 2005, facilities needed to use only 5% of their total energy output for industrial purposes to attain Qualifying Facility (QF) status. This low bar for defining a CHP application was increased to 50% under EPACT 2005, which means that fewer CHP facilities can attain QF status, so there is no longer an obligation for utilities to buy their power via purchase power agreements (PPAs) (Duvall, 2014). Low natural gas pries and forecasts can also decrease the incentive to invest capital to save energy as with CHP systems. Figure 25 indicates that the post-2005 decline in new CHP capacity is greater in the South than the rest of the country.

With the setting of a 2012 US Executive Order establishing a national goal of 40 GW of new industrial CHP by 2020, the deployment of CHP is anticipated to increase. However, CHP remains challenged by financial, regulatory, and workforce barriers. The enforcement of interconnection standards and environmental regulations can be substantial barriers to CHP investments, especially for smaller CHP projects (Baer, Brown, & Kim, 2013).

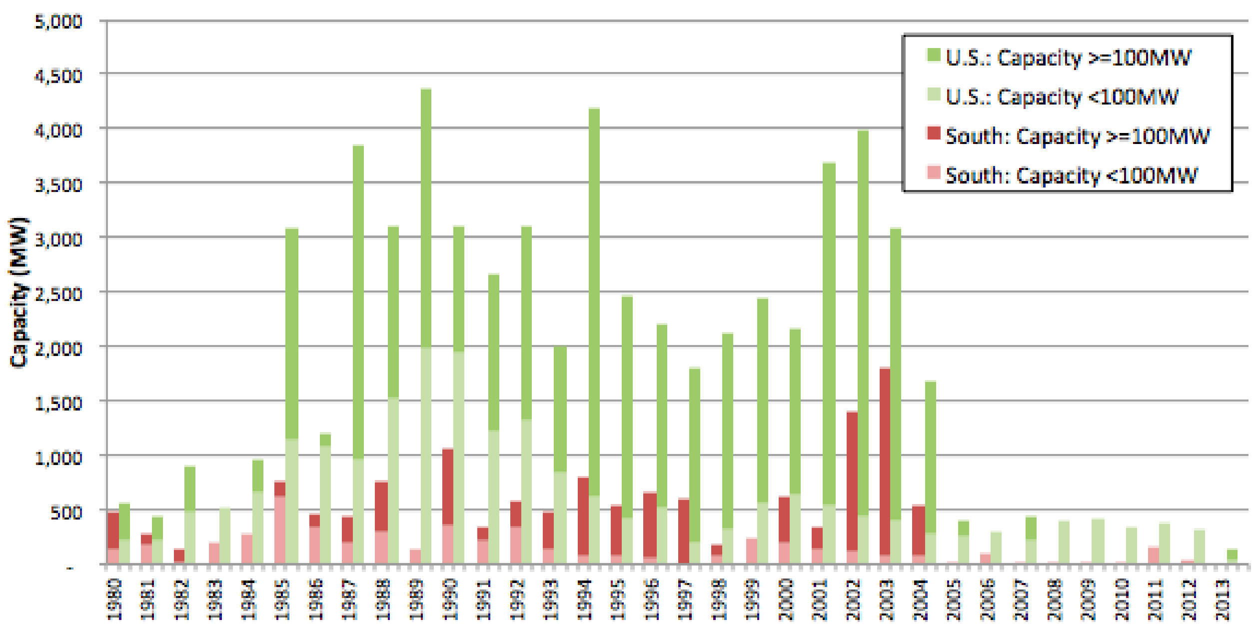

Figure 25. Annual CHP Capacity Additions in the South and the US

Source: Produced from data found at ICF, 2013

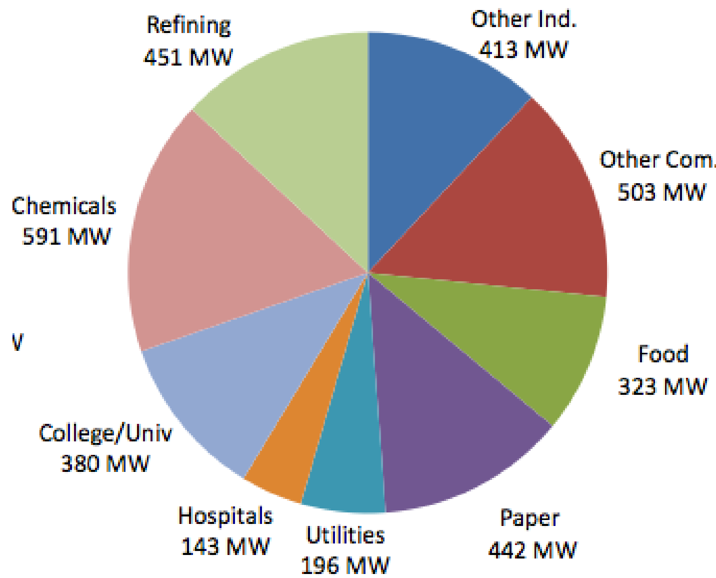

Figure 26. Existing CHP Capacity in the US
Source: Bruce Hedman, April 2013. http://www.cogeneration.org/pdf/MCA2013April4_Hedman.pdf

Figure 27 indicates that there is substantial potential to expand CHP in the South. Focusing on installations with an estimated payback of less than 10 years, Texas, Florida, North Carolina, and Georgia each have the potential to add more than 500 MW of CHP capacity. Similarly, the territory served by TVA is estimated to have 1 GW of economic industrial CHP capacity additions, based on the data shown in Figure 27.

	Existing Capacity (MW)	Technical Potential New Capacity (MW) > 10 yrs payback	5-10 yrs payback	< 5 yrs payback	Total Potential
Alabama	3,217	1,512	416	-	1,928
Arkansas	493	1,384	-	-	1,384
Delaware	172	254	144	-	398
DC	14	321	-	-	321
Florida	3,380	2,541	2,098	104	4,743
Georgia	1,231	3,256	555	-	3,811
Kentucky	123	1,607	932	-	2,539
Louisiana	6,918	1,864	658	-	2,522
Maryland	714	1,450	306	-	1,756
Mississippi	514	1,086	274	-	1,360
North Carolina	1,541	3,726	632	-	4,358
Oklahoma	694	1,295	-	-	1,295
South Carolina	1,220	1,962	386	-	2,348
Tennessee	512	2,143	594	-	2,737
Texas	17,524	5,716	1,836	384	7,936
Virginia	1,732	2,570	490	-	3,060
West Virginia	382	545	244	-	789
Total, US South	**40,381**	**33,232**	**9,565**	**488**	**43,285**

Figure 27. Southeast Remaining Potential for CHP
Source: ICF, 2013

6. The Grid in the South is Getting Smarter

The electric power systems in the South and across the country are challenged by the need to accommodate distributed renewable generation, increasing demands of a digital society, growing threats to infrastructure security, and growing concerns over global climate disruption. The “smart grid” – with a two-way flow of electricity and information between utilities and consumers – can help address these challenges. Smart meters are being deployed across the region, and the real-time data provided by these devices will enhance demand-side management programs and help isolate grid problems for quicker restoration.

Smart grid architectures can integrate a diverse set of electricity resources, including large power plants as well as distributed renewable resources, electric energy storage, demand response, and electric vehicles. Figure 28 portrays a complex smart grid system with both central and regional controllers managing the two-way flow of electricity and information between utilities and consumers. The actual mix of controls and technologies will depend upon a region’s transmission and distribution (T&D) system, its electricity governance and business model, the nature of the customers being served and other demand-side issues. By implementing a smart grid, electric systems can operate at higher levels of power quality and system security. Dynamic pricing and smart meters that enable consumers to play an active role in managing their demand for electricity can make power delivery systems more efficient. Payment systems can also be made more efficient with digital communications and can reduce non-technical losses that undermine grid economics, which is particularly important in many developing countries. Without the development of the smart grid, the full value of individual technologies such as distributed solar PV, electric cars, demand-side management, and large central station renewables such as wind and solar farms will not be fully realized.

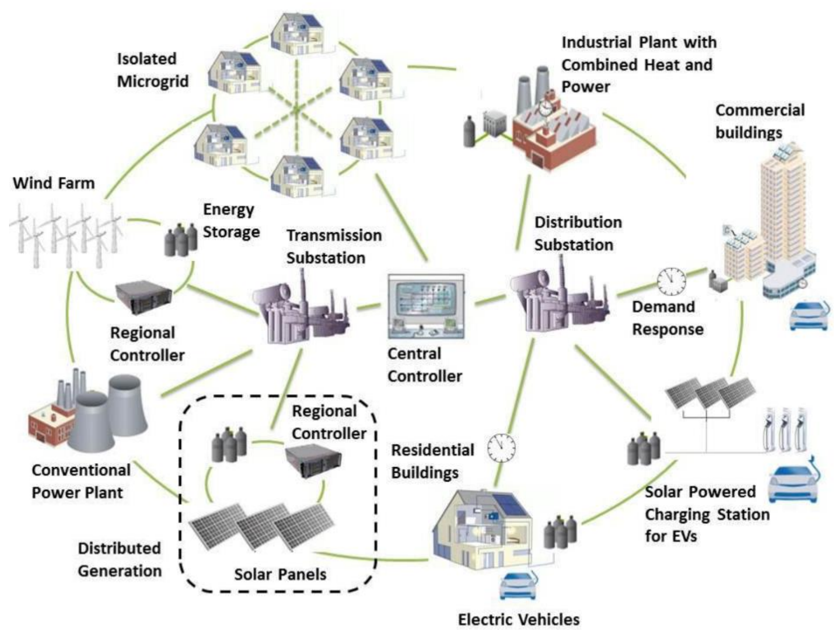

Figure 28. Smart Grid System
Source: Brown & Zhou, 2013

North Carolina and Florida are among the top 10 states utilizing stimulus funds for smart grid (Figure 29). North Carolina, in particular, is the biggest state beneficiary of federal smart grid grants, with $404 million. Georgia has a broad array of dynamic pricing programs and smart grid technology investments, but relative to California, its net metering and interconnection standards are more limited.

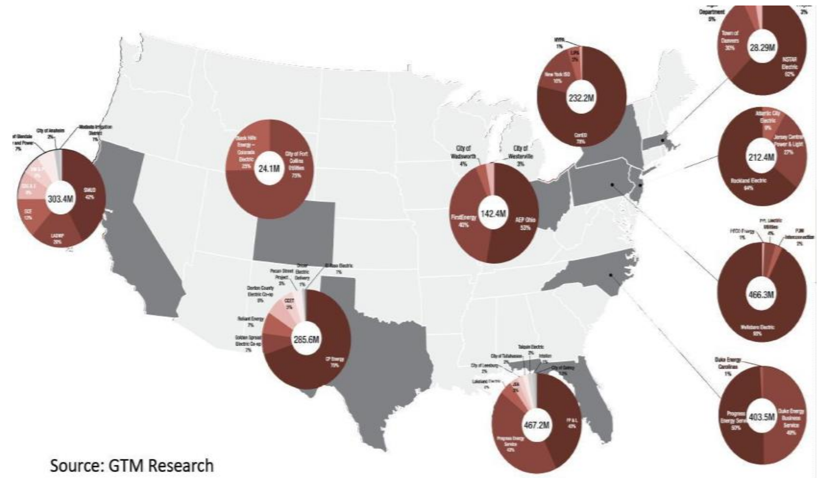

Figure 29. Top ten States Utilizing Stimulus Funds for Smart Grid
Source: Greentech Media Research, 2012

Georgia Power has been very successful in implementing dynamic pricing programs starting in the 1990s, offering various pricing options to different customers, with electricity rates ranging from 1.25 cents per kWh during super off-peak time to 19.29 cents during on-peak hours.[24] For instance, time-of-use (TOU) rates are available to residential customers and electric vehicle owners, as well as small, medium, and large businesses. Real-time-pricing (RTP) for some customers is based on day-ahead or hour-ahead power supply prices. In 2005, Georgia Power's commercial and industrial RTP programs had 1,600 participants, which represented over 5,000 MW of qualifying loads (Charles J. Black Energy Economics, 2011). As of the end of 2013, Georgia Power had 2,133 RTP accounts and 3,660 MW in the peak hour (Rossmann, 2014). TVA also has dynamic pricing, along with other utilities in the South. The availability of dynamic pricing is an important enabler of the successful operation of a smart grid.

TVA partnered with local power companies and the Tennessee Valley Public Power Association to develop an overall roadmap for deployment to include advanced metering, distribution automation, substation automation, and other emerging smart grid technologies. Advanced metering systems are at various stages of deployment by approximately one third of TVA's 155 local power companies. Plans are for deployment to rise from the present level of 30-40% of customers to nearly 100% by 2020. These systems will provide a foundation for several Smart Grid capabilities, including the support of end-use rates, increased operational efficiency, improvements in reliability, and potential integration of a range of grid monitoring and control technologies. The interval consumption data collected by these systems will provide consumers with insight into their consumption habits and will enable the calculation of potential savings for various rate and demand response scenarios (Hoagland, 2014).

Distributed generation and new load types are also driving interest in reading additional quantities from meters, such as reactive power, harmonics, coincident measurements, and logged events. Solid state meters are increasingly able to support these measurements and many AMI communication systems can

[24] Georgia Power (2011) Business pricing - Georgia power. Retrieved 29 June 2011, from http://www.georgiapower.com/pricing/residential/nights-and-weekends.cshtml

also support their transport, making it increasingly possible to monitor the power system for real and reactive power as well as harmonics and other power quality indicators (Hoagland, 2014).

7. Grid Reliability in the Southeast

The Federal Power Act requires the development of mandatory and enforceable reliability standards.[25] The current list of such standards includes standards on protection and control (17), interconnection reliability operations and coordination (15), modeling, data, and analysis (14), resource and demand balancing (10), facilities design, collections, and maintenance (9), transmission operations (9), interchange scheduling coordination (9), critical infrastructure protection (8), emergency preparedness and operations (7), personnel performance, training, and qualifications (4), transmission planning (4), and voltage and reactive power (4) communications (2), and nuclear (1).

In December 2013, NERC prepared its annual 2013 Long Term Reliability Assessment report under the direction of its Planning Committee. The data provided in the report had been obtained from each of the eight Regional Entities. Such reports are used "to leverage the knowledge and experience of subject matter experts who represent NERC Regions and the electricity industry at large." The report includes regionally presented long-term projections and highlights, projected demand, resources, and reserve margins, as well as long-term reliability challenges and emerging issues. While in the past the *operating reliability* mainly included the ability to extend operation during sudden, unexpected disturbances (most commonly caused by short-circuits or unanticipated equipment failures), nowadays the security focus is expanding to include withstanding disturbances caused by man-made physical or cyber attacks. The *adequacy* is a matter of sufficiency of resources that provide customers with continued supply of electricity under normal circumstances (voltage and frequency). Resources include a combination of electricity generation and transmission facilities, as well as demand response programs that curtail customer demand. Another aspect of reliability, less related to electricity infrastructure, is *fuel security*.

Among the impacts to long-term reliability, the following three overarching risk areas are considered: resource and transmission adequacy, integration of new technologies and operations, and long-term system planning and modeling. Among the general conclusions of the report, high levels of variable generation (generation whose output depends on stochastic fuel inputs, such as wind and solar, and even some forms of hydro) are deemed as having potential to present operational and planning challenges. In the next 10-year period, over 46 GW of wind and solar installed capacity is planned. Among the measures planned to be undertaken are to expand NERC methodology for reliability assessment (to include the development of metrics for further evaluation in future long-term reliability assessments), developing primary and essential reliability services (to include frequency response, inertia, voltage stability, and other operational requirements needed to ensure reliability), initiating focused assessment (comprehensive assessment of essential reliability services for areas and systems approaching 20 or more percent variable resources over the next 10 years), and active engagement with IEEE (in its own standards development activities which include a very important IEEE 1547 stakeholder

[25] According to North American Reliability Corporation (NERC), Section 215 of the Federal Power Act provides this authorization.

group) in order to capture the knowledge and experience with new technologies and their integration in much larger scale expected in the future.

Another conclusion of the NERC report is that the increased use of demand-side management (DSM) creates more uncertainty. Those uncertainties concern performance and availability, but also the ability for sustained participation in the long-term of demand response programs. Recommendations to address these concerns include enhancing performance analysis (identify availability and performance trends that may indicate future risks), and to evaluate the need for requirements or guidelines (to support demand response programs).

NERC Regional Entities	
FRCC	Florida Reliability Coordinating Council
MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RFC	Reliability*First* Corporation
SERC	SERC Reliability Corporation
SPP-RE	Southwest Power Pool Regional Entity
TRE	Texas Reliability Entity
WECC	Western Electricity Coordinating Council

NERC Assessment Areas Map

Figure 30. NERC Regional Entities

(Note: SERC is further subdivided into four regions, and SERC-SE contains portions of four states including Georgia, Florida, Alabama and Mississippi)

SERC-SE is predominantly summer peaking region serving about 14.2 million customers over approximately hundred and 20,000 square miles.

Concerning transmission resources into the southeast region, there were 27,672 circuit miles by the end of 2012, with 41 circuit miles under construction, another 560 planned in 2013 – 2018, and an additional 57 circuit miles of additions in the same timeframe. Another 118 circuit miles are planned for 2019 – 2023. Planned additions in other regions include a 2500-mile Canada/Pacific Northwest – Northern California Transmission Project (500 kV), and the addition of 1600 circuit miles in Texas coming into service in 2014 to support ERCOT wind integration efforts.

Planning Reserve Margins

SERC-SE-Summer		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
ANTICIPATED		36.76%	28.01%	29.73%	30.48%	29.09%	27.08%	25.47%	23.57%	21.67%	19.78%
PROSPECTIVE		40.78%	31.96%	33.61%	34.30%	32.88%	30.81%	29.14%	27.19%	25.24%	23.29%
ADJUSTED POTENTIAL		41.03%	32.20%	35.78%	39.80%	38.33%	36.19%	35.08%	33.04%	30.99%	28.96%
NERC REFERENCE	-	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**
SERC-SE-Winter		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
ANTICIPATED		49.08%	40.76%	43.07%	44.29%	39.52%	40.19%	38.16%	36.11%	34.07%	32.05%
PROSPECTIVE		53.56%	45.18%	47.42%	48.61%	43.77%	44.38%	42.29%	40.18%	38.07%	36.00%
ADJUSTED POTENTIAL		53.72%	45.34%	51.41%	54.66%	49.74%	50.26%	48.76%	46.56%	44.36%	42.19%
NERC REFERENCE	-	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**	**14.99%**

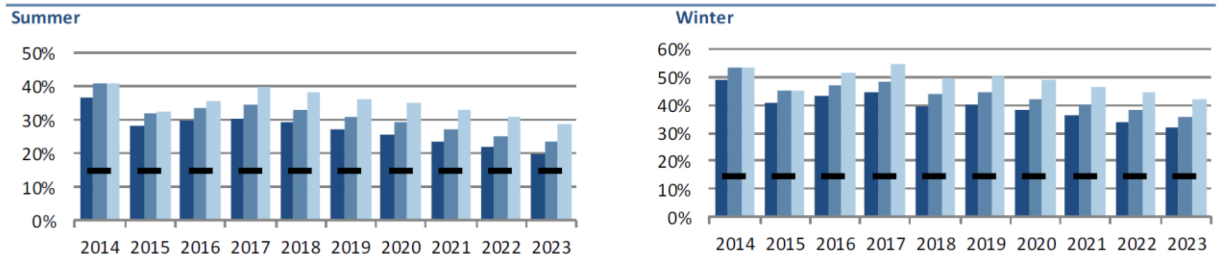

Figure 31. Planning Reserve Margins in the SERC-SE region over the Next 10 Years

Source: NERC. 2013. Reliability Assessment Report

As far as demand, resources, and reserve margin projections for the summer of 2018, the SERC-SE region is estimating about 3 GW of net load growth, for a total forecast of 49,569 MW net load, with anticipated capacity resources of 63,991 MW (potentially as large as 68,568 MW) representing planning reserve margins between 29.9% and 38.33%. For the summer of 2023, the anticipated load growth is forecast to bring demand to 53,466 MW (55,760 MW including losses) with anticipated capacity resources of 64,044 MW (potentially as large as 68,949 MW), which represents planning reserve margins between 19.78% and 28.96%. This high level of reserves is due mainly to the forecast of slow demand growth caused by a sluggish economic recovery. However, operating margins are expected to diminish over time. These trends are going against the anticipated increase of variable generation resources and increased use of demand response programs, both of which are expected to require planning reserve margins to sustain reliable operation of the system.

The introduction of EPA MATS and other impending environmental rules creates reliability concerns, forcing utilities to work with generator operators to reassess resource availability and potential unit retirements. Extensive generation and transmission construction work must be completed prior to the implementation of MATS in 2015 or subsequent years.

8. Conclusions

This assessment of the state of electric power in the South highlights great diversity within the region, but also identifies a number of general features that distinguish power systems in the South from those in the rest of the nation. First, the South has a distinct electricity generation profile. Coal has historically dominated, but the South has seen a dramatic increase in the fraction of electricity generated by natural gas, enabled by the region's well-developed gas pipeline infrastructure and proximity to a historic gas source region. The South is also home to all of the nation's current US nuclear reactor construction projects.

Few Southern states have renewable requirements and most have limited renewable generation. Exceptions are the long-standing cost-competitive hydropower in Tennessee, Alabama, and North Carolina and the significant and more recent wind development in Texas and Oklahoma. Despite the region's ample biomass resources, biopower in the South is not growing. Solar power is relatively more expensive in the South (due to a combination of higher costs and lower electricity prices). Its market penetration would get a boost with more supportive net metering policies. Recent solar expansion in North Carolina and Georgia appears to be signaling the emergence of new solar PV opportunities.

The South has relatively low electric rates, which have been instrumental to its economic development. Because of low rates, warm climates, and a reliance on electric heating as well as cooling, buildings and industrial facilities in the South tend to be electricity intensive. The South exhibited early leadership in industrial demand-side management and demand-response programs, and local utilities continue to promote energy efficiency. Still, the South has a significant opportunity to expand its energy efficiency performance by strengthening its policies. As an example, CHP is a clean and efficient energy resource, but it is underdeveloped relative to its significant economic potential for expansion.

Finally, evidence suggests that the grid in the South is getting smarter and has benefited from DOE smart grid grants. At the same time, the region is challenged by sluggish load growth, the need to accommodate distributed renewable generation, increasing demands of a digital society, growing threats to infrastructure security, and concerns over environmental quality and global climate disruption. The region can take pride in the fact that it has never been exposed to the sort of disruptions and blackouts that other parts of the national system have experienced in the past. By acting cautiously in the presence of many challenges, local utilities may have extended the time line of the clean energy transition, but they are also now able to move forward from a strong position.

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Appendix A: Backup Documentation

The following tables provide back-up documentation to the discussion of energy efficiency in Sections 1 and 5. In particular, the data in Table A-1 were used to create Figure 3.

Table A-1. Electricity Intensity by Sector in the South vs. the US Average, in 2012

	National Electricity Consumption (Million kWh)	National GDP (Million $)	National Electricity Intensity (kWh/$)	Electricity Consumption in the South (Million kWh)	South GRP[a] (Million $)	South Electricity Intensity (kWh/$)
Excluding Texas and Oklahoma from the South						
Industrial	986,166	3,246,200	0.3	309,934	744,449	0.42
Commercial	1,327,345	12,423,315	0.11	421,952	3,115,929	0.14
Residential[b]	1,374,502	16,141,152	0.09	499,120	3,981,381	0.13
Total[c]	3,688,013	16,141,152	0.23	1,231,006	3,981,381	0.31
Including Texas and Oklahoma in the South						
Industrial	986,166	3,246,200	0.3	421,364	1,289,571	0.33
Commercial	1,327,345	12,423,315	0.11	575,029	4,145,622	0.14
Residential[b]	1,374,502	16,141,152	0.09	659,319	5,615,834	0.12
Total[c]	3,688,013	16,141,152	0.23	1,655,712	5,615,834	0.29

Note: Data used to create Figure 3.
[a]GRP: Gross Regional Product
[b]Total National GDP and Total GRP in the South are used for the residential sector.
[c]Total excludes transportation sector

Sources:

EIA http://www.eia.gov/electricity/data/state/

US Bureau of Economic Analysis
http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=4&isuri=1&7003=200&7001=1200&7002=1&7090=70

Table A-1a. Manufacturing Sector Electric Intensity, in 2012

State	Retail Electricity Sales To Manufacturers (Trillion Btu)*	Retail Electricity Sales to Manufacturers (Million kWh)**	State Industrial GSP (Million $)***	Manufacturing Electric Intensity (kWh/$ Manufacturing GSP)
Alabama	115.2	0.03	47,079	0.72
Alaska	4.7	0.00	22,808	0.06
Arizona	42.5	0.01	45,370	0.27
Arkansas	57.5	0.02	27,063	0.62
California	160.2	0.05	36,7120	0.13
Colorado	52.6	0.02	49,874	0.31
Connecticut	12.2	0.00	34,916	0.1
Delaware	9.4	0.00	6,589	0.42
District of Columbia	0.7	0.00	1,503	0.14
Florida	56.0	0.02	79,970	0.21
Georgia	106.5	0.03	73,303	0.43
Hawaii	12.5	0.00	5,932	0.62
Idaho	32.7	0.01	14,264	0.67
Illinois	154.5	0.05	134,101	0.34
Indiana	164.3	0.05	111,004	0.43
Iowa	66.6	0.02	45,932	0.42
Kansas	37.7	0.01	34,846	0.32
Kentucky	150.8	0.04	47,666	0.93
Louisiana	103.9	0.03	101,019	0.3
Maine	10.3	0.00	8,729	0.35
Maryland	15.4	0.00	3,6012	0.13
Massachusetts	57.8	0.02	59,022	0.29
Michigan	108.6	0.03	96,658	0.33
Minnesota	79.9	0.02	67,319	0.35
Mississippi	57.4	0.02	25,392	0.66
Missouri	60.0	0.02	49,982	0.35
Montana	14.2	0.00	9,775	0.43
Nebraska	40.7	0.01	26,781	0.45
Nevada	46.9	0.01	21,501	0.64
New Hampshire	6.7	0.00	10,234	0.19
New Jersey	26.5	0.01	63,909	0.12
New Mexico	24.7	0.01	19,006	0.38
New York	46.8	0.01	110,432	0.12
North Carolina	91.8	0.03	117,258	0.23
North Dakota	17.5	0.01	1,7460	0.29
Ohio	182.1	0.05	123,007	0.43

State	Retail Electricity Sales To Manufacturers (Trillion Btu)*	Retail Electricity Sales to Manufacturers (Million kWh)**	State Industrial GSP (Million $)***	Manufacturing Electric Intensity (kWh/$ Manufacturing GSP)
Oklahoma	56.5	0.02	4,9180	0.34
Oregon	41.0	0.01	72,963	0.16
Pennsylvania	163.9	0.05	116,044	0.41
Rhode Island	3.2	0.00	6,329	0.15
South Carolina	96.1	0.03	39,840	0.71
South Dakota	9.3	0.00	1,0750	0.25
Tennessee	97.2	0.03	58,025	0.49
Texas	323.7	0.09	495,942	0.19
Utah	33.1	0.01	31,218	0.31
Vermont	4.9	0.00	4,946	0.29
Virginia	59.1	0.02	63,504	0.27
Washington	94.2	0.03	77,610	0.36
West Virginia	40.5	0.01	20,226	0.59
Wisconsin	80.4	0.02	67,644	0.35
Wyoming	34.2	0.01	19,141	0.52
United States	3,364.8	0.99	3,246,200	0.3

Notes: Data used to create Figure 3 manufacturing electric intensity

*Source: EIA http://www.eia.gov/electricity/data/state/

** Converted from the previous column using the following formula: 3412 Btu = 1kWh

***Source: US Bureau of Economic Analysis
http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=4&isuri=1&7003=200&7001=1200&7002=1&7090=70

Table A-1b. Business Sector Electric Intensity, in 2012

State	Retail Electricity Sales To Businesses (Trillion Btu)*	Retail Electricity Sales to Businesses (Million kWh)**	State Commercial GSP (Million $)***	Business Electric Intensity (kWh/$ Commercial GSP)
Alabama	74.4	0.02	137,260	0.16
Alaska	9.8	0.00	30,451	0.09
Arizona	101.3	0.03	218,063	0.13
Arkansas	41.3	0.01	87,066	0.14
California	415.7	0.12	1,709,948	0.07
Colorado	68.3	0.02	221,334	0.09
Connecticut	44.4	0.01	203,401	0.06
Delaware	14.5	0.00	53,189	0.08
District of Columbia	29.7	0.01	109,982	0.08
Florida	314	0.09	665,866	0.14
Georgia	156.7	0.05	347,122	0.13
Hawaii	11	0.00	63,502	0.05
Idaho	20.4	0.01	42,256	0.14
Illinois	173.4	0.05	544,515	0.09
Indiana	82	0.02	185,716	0.13
Iowa	41.7	0.01	105,421	0.12
Kansas	52.7	0.02	98,733	0.16
Kentucky	64	0.02	122,096	0.15
Louisiana	82.7	0.02	140,941	0.17
Maine	13.8	0.00	43,292	0.09
Maryland	102.8	0.03	293,681	0.1
Massachusetts	60.5	0.02	365,916	0.05
Michigan	131.4	0.04	309,350	0.12
Minnesota	76.8	0.02	222,768	0.1
Mississippi	46.4	0.01	72,640	0.19
Missouri	104	0.03	210,444	0.14
Montana	16.8	0.00	30,364	0.16
Nebraska	31.5	0.01	68,814	0.13
Nevada	31.8	0.01	102,012	0.09
New Hampshire	15.3	0.00	54,850	0.08
New Jersey	131.3	0.04	448,778	0.09
New Mexico	31.3	0.01	67,801	0.14
New York	259.4	0.08	1,146,176	0.07
North Carolina	158.7	0.05	325,085	0.14
North Dakota	17.4	0.01	29,409	0.17
Ohio	159.5	0.05	409,508	0.11

State	Retail Electricity Sales To Businesses (Trillion Btu)*	Retail Electricity Sales to Businesses (Million kWh)**	State Commercial GSP (Million $)***	Business Electric Intensity (kWh/$ Commercial GSP)
Oklahoma	68.1	0.02	116,057	0.17
Oregon	53.9	0.02	132,305	0.12
Pennsylvania	146.4	0.04	495,354	0.09
Rhode Island	12.4	0.00	44,388	0.08
South Carolina	72.5	0.02	134,167	0.16
South Dakota	15.5	0.00	32,000	0.14
Tennessee	96	0.03	209,118	0.13
Texas	454.2	0.13	913,636	0.15
Utah	36.9	0.01	98,852	0.11
Vermont	6.8	0.00	22,947	0.09
Virginia	159.5	0.05	370,433	0.13
Washington	99.8	0.03	302,174	0.1
West Virginia	26.5	0.01	47,283	0.16
Wisconsin	79.3	0.02	196,695	0.12
Wyoming	14.5	0.00	20,160	0.21
United States	4528.9	1.33	12,423,315	0.11

Notes: Data used to create Figure 3 businesses electric intensity

*Source: EIA http://www.eia.gov/electricity/data/state/

** Converted from the previous column using the following formula: 3412 Btu = 1kWh

***Source: US Bureau of Economic Analysis
http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=4&isuri=1&7003=200&7001=1200&7002=1&7090=70

Table A-1c. Residential Sector Electric Intensity, in 2012

State	Retail Electricity Sales To Homes (Trillion Btu)*	Retail Electricity Sales to Homes Million (kWh)**	Total State GSP (Million $)***	Residential Electric Intensity (kWh/$ Total GSP)	Residential Electricity Consumption per Capita (kWh/person)
Alabama	104.5	0.03	189,542	0.16	0.0064
Alaska	7.4	0.00	59,643	0.04	0.0031
Arizona	112.3	0.03	271,503	0.12	0.0051
Arkansas	61.1	0.02	118,993	0.15	0.0061
California	307.5	0.09	2,125,717	0.04	0.0024
Colorado	62.2	0.02	278,551	0.07	0.0036
Connecticut	43.5	0.01	242,930	0.05	0.0036
Delaware	15.4	0.00	60,650	0.07	0.0050
District of Columbia	6.8	0.00	111,870	0.02	0.0033
Florida	382.6	0.11	769,007	0.15	0.0060
Georgia	183.1	0.05	438,324	0.12	0.0055
Hawaii	9.3	0.00	72,512	0.04	0.0020
Idaho	27.8	0.01	58,231	0.14	0.0052
Illinois	160.0	0.05	704,138	0.07	0.0037
Indiana	112.5	0.03	306,838	0.1	0.0051
Iowa	47.7	0.01	156,606	0.09	0.0046
Kansas	47.1	0.01	138,958	0.1	0.0048
Kentucky	89.0	0.03	177,967	0.15	0.006
Louisiana	102.5	0.03	251,369	0.12	0.0066
Maine	15.3	0.00	53,235	0.08	0.0034
Maryland	91.0	0.03	336,481	0.08	0.0046
Massachusetts	69.3	0.02	431,937	0.05	0.0031
Michigan	117.6	0.03	416,769	0.08	0.0035
Minnesota	75.3	0.02	298,272	0.07	0.0042
Mississippi	61.4	0.02	101,549	0.17	0.0061
Missouri	117.2	0.03	269,356	0.13	0.0057
Montana	16.3	0.00	42,140	0.11	0.0048
Nebraska	33.0	0.01	103,062	0.09	0.0053
Nevada	41.4	0.01	128,896	0.09	0.0045
New Hampshire	15.1	0.00	66,111	0.07	0.0034
New Jersey	97.8	0.03	528,788	0.05	0.0033
New Mexico	23.1	0.01	89,188	0.08	0.0033
New York	173	0.05	1,280,737	0.04	0.0026
North Carolina	186.5	0.05	452,358	0.12	0.0057
North Dakota	15.3	0.00	49,509	0.09	0.0067
Ohio	178.4	0.05	548,526	0.1	0.0045

State	Retail Electricity Sales To Homes (Trillion Btu)*	Retail Electricity Sales to Homes Million (kWh)**	Total State GSP (Million $)***	Residential Electric Intensity (kWh/$ Total GSP)	Residential Electricity Consumption per Capita (kWh/person)
Oklahoma	77.8	0.02	171,432	0.13	0.0061
Oregon	64.3	0.02	210,242	0.09	0.0049
Pennsylvania	180.4	0.05	629,851	0.08	0.0042
Rhode Island	10.7	0.00	51,566	0.06	0.0030
South Carolina	96.8	0.03	177,985	0.16	0.0061
South Dakota	15.2	0.00	43,758	0.1	0.0055
Tennessee	135.6	0.04	280,485	0.14	0.0063
Texas	468.8	0.14	1,463,021	0.09	0.0055
Utah	31.4	0.01	134,483	0.07	0.0033
Vermont	7.1	0.00	28,422	0.07	0.0033
Virginia	148.5	0.04	445,090	0.1	0.0054
Washington	121.2	0.04	390,918	0.09	0.0053
West Virginia	38.2	0.01	69,711	0.16	0.0060
Wisconsin	75.2	0.02	272,086	0.08	0.0039
Wyoming	9.3	0.00	41,839	0.06	0.0048
United States	4,689.8	1.37	16,141,152	0.09	0.0045
South	2,249.6	0.66	5,615,834	0.12	0.0058
South (Excluding OK & TX)	1,703.0	0.50	3,981,381	0.13	0.0058

Notes: Notes: Data used to create Figure 3 homes electric intensity

*Source: EIA http://www.eia.gov/electricity/data/state/

** Converted from the previous column using the following formula: 3412 Btu = 1 kWh

***Source: US Bureau of Economic Analysis
http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=4&isuri=1&7003=200&7001=1200&7002=1&7090=70

Table A-2. The Most Electricity Intensive Industries in the US, in 2011

(The top seven industries are selected as the electricity-intensive industries)

NAICS industry	Electricity Consumption	Electricity Intensity
331 Primary Metals	**458**	**7.57**
313 Textile Mills 314 Textile Product Mills	**86**	**5.48**
322 Paper	**247**	**4.63**
321 Wood Products	**91**	**4.12**
327 Nonmetallic Mineral Products	**147**	**4.02**
326 Plastics and Rubber Products	**182**	**2.76**
325 Chemicals	**517**	**1.52**
337 Furniture and Related Products	32	1.40
311 Food 312 Beverage and Tobacco Products	281	1.28
323 Printing and Related Support	45	1.15
332 Fabricated Metal Products	143	1.14
335 Electrical Equipment, Appliances, and Components	44	0.88
336 Transportation Equipment	195	0.87
333 Machinery	111	0.81
324 Petroleum and Coal Products	137	0.79
315 Apparel 316 Leather and Allied Products	8	0.77
339 Miscellaneous	33	0.40
334 Computer and Electronic Products	94	0.38

Note: Data used to support the discussion of electricity intensity in Section 1 Figure 3.

Table A-3. Percent of GSP in Electricity-Intensive Industries in the South (16 States and DC)

(Data source: Annual Energy Review 2011, Bureau of Economic Analysis)

State	In the South	2011	State	In the South	2011
Alabama	Yes	6.58%	Montana		1.07%
Alaska		0.17%	Nebraska		3.43%
Arizona		1.30%	Nevada		0.73%
Arkansas	Yes	5.64%	New Hampshire		2.05%
California		1.97%	New Jersey		3.69%
Colorado		1.51%	New Mexico		0.65%
Connecticut		2.27%	New York		1.66%
Delaware	Yes	2.88%	North Carolina	Yes	8.07%
District of Columbia	Yes	0.10%	North Dakota		1.12%
Florida	Yes	1.16%	Ohio		5.42%
Georgia	Yes	4.32%	Oklahoma	Yes	2.21%
Hawaii		0.20%	Oregon		2.61%
Idaho		2.02%	Pennsylvania		4.61%
Illinois		3.23%	Rhode Island		3.09%
Indiana		11.52%	South Carolina	Yes	7.25%
Iowa		5.08%	South Dakota		1.79%
Kansas		2.61%	Tennessee	Yes	4.59%
Kentucky	Yes	4.60%	Texas	Yes	3.82%
Louisiana	Yes	8.13%	Utah		5.58%
Maine		3.81%	Vermont		1.68%
Maryland	Yes	2.20%	Virginia	Yes	2.22%
Massachusetts		1.98%	Washington		1.54%
Michigan		3.26%	West Virginia	Yes	5.66%
Minnesota		2.66%	Wisconsin		5.36%
Mississippi	Yes	4.68%	Wyoming		1.60%
Missouri		3.59%			
US Average		**3.34%**			

Note: Data used to support the discussion of electricity intensity in the industrial sector in Figure 3.

Table A-4a. Home Heating Fuels as a Percentage of Home Heating Consumption, in 2012

(Note: Ranked by share of electric heating)

Census Division	In the South	Natural Gas	Electricity
South Atlantic	Yes	24.80%	66.00%
East South Central	Yes	32.60%	57.60%
West South Central	Yes	38.90%	55.50%
Mountain		58.20%	32.60%
Pacific		56.70%	32.50%*
West North Central		60.10%	24.80%
East North Central		71.40%	17.10%
Mid-Atlantic		58.10%	14.30%
New England		36.90%	12.30%
US Average		**48.63%**	**34.74%**

Note: Data used to support the discussion of electricity intensity in the residential sector in Figure 3.

Table A-4b. Home Heating Fuels, CDDs, HDDs, and Residential Electricity Intensity, in 2012

State and Weather Station Used for HDDs and CDDs	**% Electric Home Heating**	**% Natural Gas Home Heating**	**CDDs**	**HDDs**	**CDDs + HDDs**	**Residential Electricity Intensity** (kWh/$ Total GSP)
Mississippi (Oxford: KUOX)	52.6	31.6	1862	3001	4863	0.17
Alabama (Birmingham: KBHM)	59.6	30.5	2299	2202	4501	0.16
South Carolina (Columbia: KCAE)	67.6	24.2	2504	2105	4609	0.16
Florida (Gainesville: KGNV)	92.2	4.6	2940	1189	4129	0.15
Tennessee (Nashville: KBNA)	58.3	34	2097	3056	5153	0.14
Georgia (Atlanta: KFTY)	50.6	41.9	2083	2504	4587	0.12
North Carolina (Charlotte: KCLT)	58.3	25.0	1872	2770	4642	0.12
Texas (Austin: KAUS)	57.0	38.1	3257	1634	4891	0.09
Arizona (Phoenix: KPHX)	58.2	35.3	5268	983	6251	0.12

Source for share of electric heating:
http://www.eia.gov/state/data.cfm?sid=AZ#ConsumptionExpenditures)

Source for HDDs and CDDs: http://www.degreedays.net

Table A-5 Energy Star Qualified Appliance Retail Sales Data for 2009

Appliance Type	Percent Energy Star Purchases	
	US	South
Air Conditioners	36%	34%
Clothes Washers	48%	44%
Dishwashers	68%	62%
Refrigerators	35%	34%
Water Heating	2%	1%

Author calculations based on data provided by:
http://www.energystar.gov/index.cfm?c=manuf_res.pt_appliances

Table A-6. Percent Electricity Generation, by Source, in the South, in 2012

Including TX and OK:

Fuel	East South Central	South Atlantic	West South Central	South as a whole
Coal	45.6%	35.6%	32.1%	36.4%
NG	28.1%	35.2%	48.6%	38.7%
Nuclear	19.5%	24.7%	10.3%	18.2%
Other	0.1%	0.6%	0.1%	0.3%
Other Gases	0.1%	0.1%	0.6%	0.3%
Petroleum	0.5%	0.4%	0.7%	0.5%
Pumped Storage	0.0%	-0.4%	0.0%	-0.2%
Renewables	6.3%	3.9%	7.6%	5.8%

Excluding TX and OK:

Fuel	East South Central	South Atlantic	West South Central	South as a whole
Coal	45.6%	35.6%	29.6%	37.7%
NG	28.1%	35.2%	44.9%	34.4%
Nuclear	19.5%	24.7%	18.5%	22.4%
Other	0.1%	0.6%	0.2%	0.4%
Other Gases	0.1%	0.1%	0.7%	0.1%
Petroleum	0.5%	0.4%	1.8%	0.6%
Pumped Storage	0.0%	-0.4%	0.0%	-0.2%
Renewables	6.3%	3.9%	4.1%	4.6%

Source: Spreadsheet calculations using EIA data from http://www.eia.gov/electricity/data/state/

Table A-7. Electric Efficiency Program Budgets, by State, in 2012

	Utilities' Electric Efficiency Program Budget ($ Million)	Program Budget as a Percent of Statewide Utility Revenues	State population	Per Capita Program Budget ($/Capita)
Alabama	10.1	0.13%	4,822,023	2.09
Alaska	0	0.00%	731,449	0.00
Arizona	124	1.69%	6,553,255	18.92
Arkansas	50.3	1.42%	2,949,131	17.06
California	1166.6	3.28%	38,041,430	30.67
Colorado	81.4	1.62%	5,187,582	15.69
Connecticut	128.1	2.79%	3,590,347	35.68
Delaware	3.8	0.30%	917,092	4.14
District of Columbia	12.2	0.92%	632,323	19.29
Florida	200	0.87%	19,317,568	10.35
Georgia	29.9	0.25%	9,919,945	3.01
Hawaii	35.6	1.09%	1,392,313	25.57
Idaho	38.7	2.39%	1,595,728	24.25
Illinois	208.6	1.72%	12,875,255	16.20
Indiana	62.7	0.73%	6,537,334	9.59
Iowa	90.6	2.56%	3,074,186	29.47
Kansas	12.3	0.33%	2,885,905	4.26
Kentucky	36.4	0.57%	4,380,415	8.31
Louisiana	3.7	0.06%	4,601,893	0.80
Maine	23.4	1.71%	1,329,192	17.60
Maryland	139.2	1.99%	5,884,563	23.66
Massachusetts	515.7	6.78%	6,646,144	77.59
Michigan	169.2	1.47%	9,883,360	17.12
Minnesota	156	2.60%	5,379,139	29.00
Mississippi	11.9	0.29%	2,984,926	3.99
Missouri	26.3	0.38%	6,021,988	4.37
Montana	21	1.84%	1,005,141	20.89
Nebraska	17.5	0.70%	1,855,525	9.43
Nevada	42	1.34%	2,758,931	15.22
New Hampshire	22.9	1.48%	1,320,718	17.34
New Jersey	329.4	3.16%	8,864,590	37.16
New Mexico	19.7	0.96%	2,085,538	9.45
New York	668.9	3.09%	19,570,261	34.18
North Carolina	61.7	0.53%	9,752,073	6.33
North Dakota	0	0.00%	699,628	0.00
Ohio	200.7	1.45%	11,544,225	17.39

	Utilities' Electric Efficiency Program Budget ($ Million)	Program Budget as a Percent of Statewide Utility Revenues	State population	Per Capita Program Budget ($/Capita)
Oklahoma	34.1	0.77%	3,814,820	8.94
Oregon	153	3.98%	3,899,353	39.24
Pennsylvania	257	1.80%	12,763,536	20.14
Rhode Island	61.4	7.61%	1,050,292	58.46
South Carolina	40.5	0.58%	4,723,723	8.57
South Dakota	4.8	0.48%	833,354	5.76
Tennessee	58.2	0.65%	6,456,243	9.01
Texas	144.4	0.46%	26,059,203	5.54
Utah	36.1	1.55%	2,855,287	12.64
Vermont	39.3	5.20%	626,011	62.78
Virginia	0.2	0.00%	8,185,867	0.02
Washington	344.8	5.37%	6,897,012	49.99
West Virginia	9.9	0.40%	1,855,413	5.34
Wisconsin	78.7	1.08%	5,726,398	13.74
Wyoming	6	0.49%	576,412	10.41
US Total	5988.9	1.63%	313,914,040	19.08

Source: Downs, Annie, Anna Chittum, Sara Hayes, Max Neubauer, Shruti Vaidyanathan, Kate Farley, and Celia Cui. 2013.*The 2013 State Energy Efficiency Scorecard*. Washington D.C.

Table A-8. Electric Efficiency Program Budgets for States in the South

	Utilities' Electric Efficiency Program Budget ($ Million)	**Program Budget as a % of Statewide Utility Revenues**	**State population**	**Per Capita Program Budget ($/Capita)**
Alabama	10.1	0.13%	4,822,023	2.09
Arkansas	50.3	1.42%	2,949,131	17.06
Delaware	3.8	0.30%	917,092	4.14
District of Columbia	12.2	0.92%	632,323	19.29
Florida	200.0	0.87%	19,317,568	10.35
Georgia	29.9	0.25%	9,919,945	3.01
Kentucky	36.4	0.57%	4,380,415	8.31
Louisiana	3.7	0.06%	4,601,893	0.80
Maryland	139.2	1.99%	5,884,563	23.66
Mississippi	11.9	0.29%	2,984,926	3.99
North Carolina	61.7	0.53%	9,752,073	6.33
Oklahoma	34.1	0.77%	3,814,820	8.94
South Carolina	40.5	0.58%	4,723,723	8.57
Tennessee	58.2	0.65%	6,456,243	9.01
Texas	144.4	0.46%	26,059,203	5.54
Virginia	0.2	0.00%	8,185,867	0.02
West Virginia	9.9	0.40%	1,855,413	5.34
South Total	846.5	0.60%	117,257,221	7.22
South Total Without TX and OK	668.0	0.60%	87,383,198	7.64
National Total	5988.9	1.63%	313,914,040	19.08

Source: Downs, Annie, Anna Chittum, Sara Hayes, Max Neubauer, Shruti Vaidyanathan, Kate Farley, and Celia Cui. 2013.*The 2013 State Energy Efficiency Scorecard*. Washington D.C.

Appendix B: Backup Documentation on Solar Power in the South

Table B-1. Numbers of State Level Solar Tax Incentive and Rebate Programs in the US

State	In the South	Tax Incentives	State Rebates
Arizona		5	
California			4
Connecticut			1
Delaware	Yes		1
District of Colombia	Yes		1
Florida	Yes	1	
Georgia	Yes	2	
Hawaii		2	
Illinois			2
Iowa		4	
Kentucky	Yes	3	
Louisiana	Yes	2	
Maryland	Yes	2	2
Massachusetts		1	1
Montana		3	
Nebraska		2	
New Hampshire			1
New Mexico		5	
New York		1	1
North Carolina	Yes	2	
North Dakota		1	
Oklahoma	Yes	1	
Oregon		1	1
Pennsylvania			1
Rhode Island			2
South Carolina	Yes	2	
Utah		4	
Vermont		1	1
Wisconsin			1
Total number of states		19	14
Total number of states in the South		8	3
Total number of programs		45	20
Total number of programs in the South		15	4

Note: Data used to support the discussion about the stringency of solar policy in the South in Section 4.4

Source: http://dsireusa.org/solar/comparisontables/ The State Rebates for Solar PV Projects and State Tax Credits for Solar PV Project

Table B-2. Solar Resource in the US

(States in the South are marked)

Rank	State	In the South	Sun Index
1	Nevada		1.19
2	Arizona		1.18
3	New Mexico		1.16
4	California		1.00
5	Colorado		0.99
6	Texas	Yes	0.98
6	Oklahoma	Yes	0.98
7	Wyoming		0.96
8	Florida	Yes	0.95
8	Kansas		0.95
8	Utah		0.95
9	Idaho		0.93
10	Mississippi	Yes	0.92
10	Georgia	Yes	0.92
10	South Carolina	Yes	0.92
11	Arkansas	Yes	0.91
12	Louisiana	Yes	0.90
12	North Carolina	Yes	0.90
13	Alabama	Yes	0.89
13	Nebraska		0.89
14	Iowa		0.87
14	Virginia	Yes	0.87
14	South Dakota		0.87
14	Missouri		0.87
15	Montana		0.86
16	Tennessee	Yes	0.85
17	Maine		0.84
17	Maryland	Yes	0.84

Rank	State	In the South	Sun Index
17	Delaware	Yes	0.84
17	Minnesota		0.84
17	North Dakota		0.84
18	Massachusetts		0.83
18	New Hampshire		0.83
18	New York		0.83
18	Pennsylvania		0.83
18	Indiana		0.83
18	Kentucky	Yes	0.83
19	Rhode Island		0.82
20	New Jersey		0.81
20	Wisconsin		0.81
21	Connecticut		0.79
21	Illinois		0.79
21	West Virginia	Yes	0.79
22	Vermont		0.77
22	Michigan		0.77
23	Ohio		0.74
24	Oregon		0.71
25	Washington		0.67

Note: The sun index is defined as an index of the amount of direct sunlight received in each state and accounts for latitude and cloud cover. California is used as the benchmark and indexed at 1.0. The amount of direct sunlight was derived from numbers provided by the NREL's Renewable Resource Data Center. The sun index was calculated as the average number of hours of peak direct sunlight hours per year from 1960 to 1990.

Sources: *"Massachusetts Surprising Candidate for Solar Power Leadership."* Topline Strategy Group, Newton, Massachusetts. Nebraska Energy Office, Lincoln, NE.

Appendix C: Backup Documentation on CHP in the South

Since the end of 2005, there have been 90 CHP plants installed in the South, representing 700 MW of new capacity. From 1999 through 2005, the South installed 84 CHP plants, but these represented 12 GW of new capacity. Texas is the clear leader in deployed capacity in both time periods, while North Carolina and Texas are leaders in new CHP plants. The bulk chemicals industry leads capacity installations by industry, followed by refining, pulp and paper, and hospitals/healthcare. Tables C.1 and C.2 below show the installations by state and by industry for these two time periods.

Table C.1. CHP Installed by State and Industry, 1999-2005

State	# of plants	Capacity (kW)	% of plants	% of capacity
AL	4	1171000	4.76%	9.88%
AR	2	218200	2.38%	1.84%
DC	2	14000	2.38%	0.12%
DE	0	0	0.00%	0.00%
FL	4	446560	4.76%	3.77%
GA	4	52705	4.76%	0.44%
KY	4	117200	4.76%	0.99%
LA	11	1941765	13.10%	16.38%
MD	8	278102	9.52%	2.35%
MS	2	28575	2.38%	0.24%
NC	5	13830	5.95%	0.12%
OK	1	50	1.19%	0.00%
SC	6	607130	7.14%	5.12%
TN	1	7000	1.19%	0.06%
TX	23	6909400	27.38%	58.28%
VA	7	49565	8.33%	0.42%
WV	0	0	0.00%	0.00%

Table C.1. CHP Installed by State and Industry, 1999-2005 (continued)

Industry	# of plants	Capacity (kW)	% of plants	% of capacity
Agriculture	2	105	2.38%	0.00%
Business Services	1	5	1.19%	0.00%
Chemicals	24	5373935	28.57%	45.33%
Colleges/Univ.	5	73030	5.95%	0.62%
District Energy	1	205000	1.19%	1.73%
Electronics	1	1800	1.19%	0.02%
Food Processing	3	14100	3.57%	0.12%
Food Stores	0	0	0.00%	0.00%
Furniture	0	0	0.00%	0.00%
General Gov't.	4	56300	4.76%	0.47%
Hospitals/Healthcare	2	7100	2.38%	0.06%
Justice/Public Order	1	60	1.19%	0.00%
Machinery	0	0	0.00%	0.00%
Military/National Security	5	4907	5.95%	0.04%
Misc. Manufacturing	3	19710	3.57%	0.17%
Office Buildings	1	50	1.19%	0.00%
Oil/Gas Extraction	1	132000	1.19%	1.11%
Primary Metals	1	7680	1.19%	0.06%
Private Household	0	0	0.00%	0.00%
Pulp and Paper	4	373700	4.76%	3.15%
Refining	13	5253000	15.48%	44.31%
Rubber/Plastics	1	100000	1.19%	0.84%
Schools	1	200	1.19%	0.00%
Solid Waste Facilities	0	0	0.00%	0.00%
Stone/Clay/Glass	1	5200	1.19%	0.04%
Textiles	1	6000	1.19%	0.05%
Transportation Equipment	1	11000	1.19%	0.09%
Utilities	3	108500	3.57%	0.92%
Wastewater Treatment	1	10600	1.19%	0.09%
Wholesale Trade	1	2100	1.19%	0.02%
Wood Products	2	89000	2.38%	0.75%

Source: ICF, 2013

Table C.2. CHP Installed by State and Industry, 2006-Present

State	# of plants	Capacity (kW)	% of plants	% of capacity
AL	7	66525	7.78%	9.50%
AR	2	5300	2.22%	0.76%
DC	2	475	2.22%	0.07%
DE	0	0	0.00%	0.00%
FL	7	58425	7.78%	8.35%
GA	7	23900	7.78%	3.41%
KY	0	0	0.00%	0.00%
LA	4	59800	4.44%	8.54%
MD	7	24625	7.78%	3.52%
MS	3	932	3.33%	0.13%
NC	23	32277	25.56%	4.61%
OK	1	50	1.11%	0.01%
SC	4	74504	4.44%	10.64%
TN	1	250	1.11%	0.04%
TX	12	349723	13.33%	49.96%
VA	5	1895	5.56%	0.27%
WV	5	1360	5.56%	0.19%

Table C.2. CHP Installed by State and Industry, 2006-Present (Continued)

Industry	# of plants	Capacity (kW)	% of plants	% of capacity
Agriculture	6	2875	6.74%	0.41%
Business Services	1	130	1.12%	0.02%
Chemicals	7	267250	7.87%	38.26%
Colleges/Univ.	8	62855	8.99%	9.00%
Electronics	1	732	1.12%	0.10%
Food Processing	5	8225	5.62%	1.18%
Food Stores	6	2365	6.74%	0.34%
Furniture	1	231	1.12%	0.03%
General Gov't.	7	26930	7.87%	3.86%
Hospitals/Healthcare	8	80800	8.99%	11.57%
Justice/Public Order	1	65	1.12%	0.01%
Machinery	1	4200	1.12%	0.60%
Military/National Security	4	3250	4.49%	0.47%
Misc. Manufacturing	2	25390	2.25%	3.64%
Office Buildings	1	4300	1.12%	0.62%
Private Household	1	20	1.12%	0.00%
Pulp and Paper	5	142800	5.62%	20.45%
Schools	1	60	1.12%	0.01%
Solid Waste Facilities	8	15025	8.99%	2.15%
Utilities	5	18630	5.62%	2.67%
Wastewater Treatment	6	12330	6.74%	1.77%
Wholesale Trade	1	10000	1.12%	1.43%
Wood Products	3	9978	3.37%	1.43%

Source: ICF, 2013

Policy Landscape

Policy support for CHP in the South vary widely from state to state. Table C.3 below summarizes these programs that include CHP.

Table C.3 A Summary of CHP Supporting Policies in the South

	Financing Policies		Regulatory Policies		
State	**Loans**	**Tax Credits/ Exemptions**	**Energy Standards**	**Interconnection**	**Net Metering**
AL	2	--	--	--	--
AR	--	--	1	--	--
DC	--	1	--	1	1
DE	--	--	1	--	--
FL	--	3	--	1	1
GA	--	1	--	--	--
KY	1	1	--	--	--
LA	--	--	1	--	--
MD	--	--	1	1	1
MS	1	--	--	--	--
NC	1	3	2	1	--
OK	1	--	1	--	1
SC	1	3	--	1	--
TN	1	--	--	--	--
TX	--	--	--	1	--
VA	3	--	--	--	1
WV	--	--	1	1	1
Total Programs	**11**	**12**	**8**	**7**	**6**
Total States	**8**	**6**	**7**	**7**	**6**

Source: DSIRE, http://www.dsireusa.org/

CHP Industry Look-ins

The bulk chemicals industry deploys more CHP than any other industry in the South. Between 1999 and 2005, the average bulk chemicals CHP plant was 224 MW in capacity. The average capacity fell sharply after 2005, declining to 38 MW on average. The majority of these plants tend to use combined-cycle natural gas designs.

The largest of these combined-cycle natural gas plants installed in the last eight years was at Dow Chemical's Freeport Energy Center, Dow's largest manufacturing site. This particular site has a number of energy efficiency awards from the American Chemistry Council. The CHP plant is owned by Calpine, which has an agreement to provide 200 MW of electricity and 1 million pounds/hour of steam to the Dow facility. The plant came online in 2007, nearly three years after the original agreement between Dow and Calpine was negotiated.

(http://www.dow.com/sustainability/stories/operations/freeport.htm)

(http://www.calpine.com/power/plant.asp?plant=205)

Refining

Refining industries have historically deployed high levels of CHP in the South, with the average system exceeding 404 MW of capacity between 1999 and 2005. However, since 2005, no new plants have come online. Reasons for this reduction are unclear.

The Calpine Morgan Energy Center is one of the largest newer CHP plants in the refining industry, located in Alabama. It is a 720 MW natural gas combined-cycle plant and came online in 2003. It provides electricity regulation services to the Tennessee Valley Authority (TVA); this interconnection required TVA to build several miles of new transmission lines to the plant, in accordance with the Federal Power Act (PURPA being the relevant iteration of the law at the time the plant became operational).

(http://www.calpine.com/power/plant.asp?plant=75)

Pulp and Paper

Pulp and paper industries are also common users of CHP. In the South, five new plants came online after 2005, about the same as in the 1999-2005 period. Here, as in other sectors, the main difference is the capacity of the newer plants; the older plants averaged 93 MW while the newer plants average 29 MW. There are a number of different fuels used for CHP in these applications, but a boiler/steam turbine powered by biomass is the most common.

The Pratt Industries cogeneration plant was completed in 2010 in Georgia with a 9.3 MW capacity. It burns biomass, mostly waste from the mill and gasified landfill waste. The steam produced is used on-site, as is half the electricity produced by the plant.

(http://www.rockdalecitizen.com/news/2011/oct/10/gov-deal-to-visit-pratt-conyers-facility/)

Hospitals and Healthcare

Hospitals and healthcare operations represent one of the major users of CHP outside of industrial processes. Activity has increased in this area, as eight plants have been added since 2005, compared to only two in the 1999-2005 period. The newer plants average about 10MW in capacity, tending to be natural gas combustion turbine systems.

Johns Hopkins University currently has three operational CHP plants, the largest of which is located at the campus hospital. This 15 MW installation is a natural gas combustion turbine. The hospital uses the electricity on-site, and has enough thermal demand nearby to use the waste heat in a district heat fashion. The CHP plants are meant to help the university meet its sustainability goals by reducing the carbon footprint of the university.

(http://sustainability.jhu.edu/sustainability_initiatives/energy_and_climate_change/)